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Investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms

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A Research Report Submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in Partial Fulfilment of the Requirements for the M.Sc. Degree

Johannesburg, August 2014

ABSTRACT

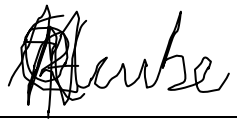
The science teacher's language, in the science classroom, has become a new language built with familiar Language of Learning and Teaching (LOLT) words, in this case English. This research study investigated the learners' ideas and understanding of simple everyday words when used in the physics classroom. The study focused on bringing to light the existence of the problem of contextual meanings of everyday words in the physics classroom language. The participants in this study were mainly English second language learners and educators from 5 high schools in the city of Johannesburg, South Africa, selected on the basis of their accessibility and socio-economic backgrounds. These consisted of 105 high school learner participants of physical science, (84 grade 11 learners and 21 grade 12 learners) and 5 physical science teacher participants (one from each school). The methods of data collection used were the questionnaire and the interview. The questionnaire items were developed using simple everyday words to test the learners' understanding of every words when used in a physics context. The learners were interviewed soon after the questionnaire was marked. The respective physical science teachers were also interviewed to further probe on their learners' answers.

The findings in this study suggest that the learners have difficulties with the contextual meanings of everyday words when used in the physics classroom. The types of difficulties included learners assuming that certain words they meet in everyday life situations still carried the same meanings when they are used in physics contexts. The sources of the difficulties were that the learners thought they understood the science classroom language and the teachers also assumed that their learners understood this language. The findings also showed that the educators fail to notice that what seems clear and simple to them may be difficult and vague to their learners.

DECLARATION

I declare that, apart from the assistance acknowledged, this research report is my own unaided work. It is being submitted in partial fulfilment of the Master of Science degree at the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination in any other university.

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Mqabuko Ncube

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I wish to thank my supervisor, Dr Samuel Ouma Oyoo for his professional guidance, patience, and solid support in writing this research report.

DEDICATION

To my children, Buhle, Nokukhanya, Bongani and Njabulo

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CHAPTER ONE

INTRODUCTION

1.1. PREAMBLE

Language is important for the teaching, learning, comprehension and communication of science concepts. According to Vygotsky (1978), language plays a very vital role in the development and formation of concepts. Furthermore, a dynamic relationship exists between language and thought such that the concepts that students have to learn cannot be fully understood if they are not represented in words. Consequently, it is a prerequisite for learners to acquire basic language skills in order to study science and to make sense of the science teacher's classroom talk or the science text language (Tao, 1994).

The big question is that 'Do learners understand meanings of most of the words used in learning science?' Cassels and Johnstone (1985, p. 1) assert that in many situations, "pupils and teachers saw familiar words and phrases which both 'understood', but the assumption that both understandings were identical was just not tenable".

This research study investigates the difficulties the learners encounter with contextual meanings of everyday words in the physics classroom language. The information was gathered using a questionnaire and interviews. The participants were 105 English second language learners of physical science and their educators from 5 high schools in the city of Johannesburg.

1.2. THE BACKGROUND OF THE STUDY

1.2.1. *The South African schooling system*

The South African schooling system is modelled as a 3-3-3-3 system, leading to the tertiary level. The first three years form the Foundation Phase or junior primary, followed by three years in the Intermediate Phase or senior primary, and then, another three years in the Senior Phase or secondary level. These first three phases are mandatory for all children of school going age. The pupils study a minimum of seven subjects, which include a subject called Natural Sciences (NS), an integration of Physics, Chemistry, and Biology. After the Senior Phase, the students may proceed to do their final three years of schooling in the Further Education and Training (FET) Phase (or pre-university level). At the end of this last phase, the learners sit for a national examination called the National Senior Certificate (NSC) or

Matriculation (Matric). In order to prepare for this all-important examination, a student must study a minimum of seven subjects, which include four compulsory subjects like Life Orientation (LO), Mathematical Literacy or Pure Mathematics and two language subjects, one of which is the language of instruction. To meet the seven subject requirement, other three subjects are selected from a wide range of learning areas but these are the subjects that determine the learner's future carrier or orientation of study at tertiary level. The science subjects that can be selected are Physical Sciences (the subject that this research is focussing on), Life Sciences (Biology) and Agricultural Sciences.

1.2.2. *Poor performance in the physical sciences subject examinations*

In the past years, Senior Certificate results in physical sciences have been very poor. The subject has been singled out as one of the most challenging and worst performed in the national examinations (Reddy, Kanjee & Diedericks, 2007). As an example, in one parliamentary session, it was once reported that "…..the 2009 Matriculation results had an extraordinary 60% of all scholars who wrote the Physical Science examinations receiving a mark less than 40%" (News 24, p. 21, 2010). Table 1.1 shows how the Physical science pass rate trails behind the national overall percentage pass rate since 2009.

Table 1.1 Summary of the national pass rate since 2009

Year	Overall pass rate (%)	Physical Science pass rate (%)
2009	60.6	36.8
2010	67.8	47.8
2011	70.2	53.4
2012	73.9	61.3
2013	78.2	67.4

This poor performance of students in science is not unique to South African students; it is a worldwide concern (Mji & Makgato, 2006; Oyoo, 2008; Reddy *et al.,* 2007; Trumper, 2006). Although an upward trend in the pass rate in physical science is recorded, this may be attributed to several intervention programmes introduced countrywide by the Department of Education (DBE) since 2010 as explained later in this section. The general performance is still poor, despite this steady increase in the pass rate. This is against the fact that the numbers of learners choosing Physical science has gradually decreased from 220900 in 2009 to 184300 in 2013; this is a percentage drop of 17% (Campbell, 2014). This means that the

physical science subject has become less attractive to the South African learners year after year since 2009.

Despite being such a challenging and poorly performed subject, some learners continue to choose physical science because it is a basic requirement for careers in engineering, medicine and architecture. Together with Mathematics, they are called gateway subjects (Campbell, 2014) whilst Trumper, (2006) refers to them as the *gatekeepers* for the aforementioned highly paying professions. According to Spoelstra (2008), the number of engineers, scientists and technicians in South Africa is decreasing and it is approaching a stagnant situation because the majority of scientists and engineers are aging people educated during the apartheid era. This might be a result of under-achievement in science at NCS examinations, leading to fewer candidates being offered training to become scientists and engineers. Spoelstra further indicates that South Africa produces 3.3 scientists and engineers per 1 000 people, falling to the bottom of the hierarchy in international scales, thus compelling South Africa to depend on expatriate labour. This is far exceeded by Brazil producing 11.2 and Australia producing 32.5 scientists and engineers per 1000 people. Several factors contribute to this dismal performance of learners in science in South Africa.

These include ill-trained teachers, lack of infrastructure, poorly equipped laboratories and low proficiency by teachers and learners in the language of teaching and learning (Mji & Makgato, 2006). All these factors may be true and important. To address these many economy based problems, the government of South Africa initiated many intervention strategies. The budget allocation for education was increased from R105 billion in 2007 to R207 billion in 2013, to represent 21% of the national budget. The allocation was meant to be used in building new infrastructure, improving existing infrastructure, electrification, provision of clean water, sanitation, buying support materials for teaching and learning, and for the transportation of learners where necessary (National Treasury Department, 2007; 2013).

According to the GDE (2010), science and mathematics learners have been receiving support in different programmes from the DBE since 2010 that include free extra lessons with (free lunch and transport) in the so-called *Saturday School Programme*, the *Star Schools Programme*, the *Walk in school camps* during school holidays and the *Secondary School Improvement Programme* (SSIP) - (of which the researcher is a participant in tutoring Physical science). Also, most mathematics and science teachers are invited to attend special

workshop programmes on teacher development. Others are offered free bursaries to study at universities in part-time programmes, upgrading their qualifications to any level they wish- the researcher in this study is a beneficiary of such support. However, these interventions seem to be inadequate in making this subject more attractive and better performed; This is evidenced by the gradual decrease in numbers of candidates choosing physical science in the past 5 years (Campbell, 2014). The type of science curriculum in South African schools, though rarely mentioned, may be a hidden factor for the apparent little success of these intervention programmes. This is explained in the following section.

1.2.3. *Physical science curriculum issues*

In the South African school curriculum, physical science is offered as an integration of two subjects, physics and chemistry. The physics component is more challenging that the chemistry component and this is corroborated by examiners' reports published by the Department of Basic Education (DBE Examiner's Report 2009). An example of such a report is presented in this study in Appendix H**.** The comments reveal that many candidates writing the Matric Examinations perform poorly in the physics component.

The researcher is concerned, as a physics specialist teacher, that this integrated approach robs learners of precious time to concentrate on the physics content. Some learners may be stronger in one of the components of the physical science, like physics and weaker in chemistry, possibly getting demoralised by the component they are weaker in. Furthermore, from the researcher's experience, limited time suggests that there is content overload in the physical science curriculum.

According to Venville, Wallace, Rennie and Malone (2008), in terms of the Parker classification (1994) of subjects, the integration of physics and chemistry to form one subject creates a 'low status' and 'weakly framed' subject, physical science, where some topics are not included in the integration process. In such situations, curriculum developers compensate for the inevitable status drop by including more topics, resulting in an overloaded curriculum in the process (Venville *et al.*, 2008). Consequently, it may be necessary to recognise the need for a separate subject approach instead of this integrated approach in teaching Physical sciences (Meana, 2009; Osborn, McNess & Broadfoot, 2000). In other SADC countries like Zimbabwe, Zambia and Tanzania, Physical science is available as separate subjects - Physics and Chemistry.

In this study, the researcher intends to investigate a language problem that may be one of the contributing factors to the aforementioned concerns (poor performance and lack of interest of learners) in the physical science subject. In the subsequent sections, issues of language problems are discussed as contributing factors to the problems faced by learners studying physics in schools.

1.2.4. *The Language of instruction and issues of proficiency*

Lack of proficiency in the language of instruction has been suggested by some researchers as one of the contributing factors to the difficulties the learners encounter in learning Physics in South Africa (Ferreira, 2011; Mji & Makgato, 2006; Muwanga-Zake, 2008). Other researchers also suggest that the use of another language in which one has no appreciable level of proficiency affects the understanding of science concepts (Howe, 2003; Makgato, 2007). The researchers further assert that this has been attributed to the fact that learners fail to understand basic concepts when explained in another language or a language that they have not mastered. These researchers also concur in that learners must be proficient in the language of instruction as a first step in understanding science concepts (Becker, 1993; Bulman, 1986).This may true be to some extent.

As a tenet of good practice, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) also suggest that learners ought to be educated in the language that they understand best (UNESCO, 2007). However, in Africa, this has not been fully realised compared to other continents. According to Oyoo (2011, p. 122), the modern African continent "has been balkanised into Francophone, Anglophone and Luzophone states in relation to the European colonial languages of French, English and Portuguese respectively" since colonial days. Because of attractiveness of these colonial languages, most African governments have opted for these same languages for their school systems hence the issue of need for learners in schools to gain proficiency in these languages.

When the Department of Education of South Africa conducted a study in 2007 to analyse the language situation in the schools, it revealed that the top language of choice for teaching and learning was English with 81.5% of the learners in the FET band studying in English, 12.5% studying in Afrikaans and a mere 6% using African languages like IsiZulu and IsiXhosa (Department of Education, 2010). This demonstrates that the suggested solution of replacing English with indigenous languages is unpopular in South African schools (Wet, 2009). The

majority of learners continue to depend on English or Afrikaans as a language of instruction instead of their home languages in schools.

Despite the well-argued issue of proficiency in the language of instruction as a strong and necessary predictor of cognitive functioning, some researchers still question it. They point out that there is no known yardstick to quantify this required level of proficiency (Adler, 1998; Oyoo, 2007). They argue that linguistic proficiency has not been found to be a sufficient condition for high academic performance.

The arguments in both ends of the issue of proficiency are important in the continued search for better ways of assisting the learner in the science classroom. The researcher is of the opinion that higher proficiency in the language of instruction is an important factor in understanding science concepts. From experience as a science teacher, learners that have a limited command of the language of instruction easily give up or become frustrated during the learning process. The majority of learners in South Africa are English second language learners (ESL). These learners have to work harder than the English first language learners (EFL) to first attain the required level of proficiency, then learn the physics classroom language and then understand the already difficult physics concepts. It is this realization that the researcher focuses on the ESL in this research.

1.2.5. *Motivation and the researcher's personal experiences*

Following several years of experience in teaching and marking national examinations for science and technology learning areas, the researcher has noted with concern that learners do not perform well because they fail to understand questions asked. Some learners frequently misinterpret the questions or instructions in homework, tests and examinations due to the inclusion of some simple everyday words that have acquired contextual meanings. Whenever the researcher explains the question, particularly the contextual meanings of some key word(s), learners immediately understand. In many instances, the learners are able to progress individually after such an intervention. I have also observed that soon after writing an examination, some learners walk out smiling saying that the paper was easy. However, in the process of marking the learners' answers, it is a different story. They do not perform well.

1.2.6. *The science teacher's classroom language*

In the science classroom, the science teacher's classroom talk is a major resource of teaching and learning. The science teacher's talk and the language of the science textbook may be

referred to as the instructional language (Oyoo, 2009). Gardner (1972) and Oyoo (2007) have asserted that this science classroom language may be divided into two components, namely the technical words (e.g. 'mass', 'force' and 'work') and non-technical words (e.g. 'random', 'negligible' and 'predict'). A detailed review of the nature and components of the science classroom language will be presented in Chapter 2. Using this classification, some everyday English words are then used in the science classroom language where they change to *attain specialized meaning* (technical) or acquire science *context meaning* (non-technical). The science teacher's language of instruction is created from such known everyday English words *with a new meaning* for the teaching and learning of science. This is a new language to the learners of science, which may confuse, de-motivate and frustrate them whenever they try to understand science concepts which are already difficult in their nature (Farrell& Ventura, 1998; Gardner, 1972/1980; Oyoo, 2007). According to Clerk and Rutherford (2000), this is a language that all learners of science have to be 'proficient' regardless of whether they are first language or second language speakers of the language of instruction (English). In a study conducted using a sample of Botswana and the U.K. learners, Johnstone and Selepeng (2001) found that the simplification of questions or the use of simple words wherever possible, enabled the performance of the learners to improve, particularly for English second language learners. Other researchers in other parts of the world involving second language speakers (Muralidhar, 1991; Tao, 1994; Ismail & Ali, 2006; Oyoo, 2008) of the language of instruction also suggest that contextual meanings of certain non-technical words confuse learners and this leads to poor performance. In South Africa, Jacobs (1989, p. 395) using first language speakers also found that the simple "lay" terms in physics texts confused learners more than the technical terms.

It is this realisation that the researcher intended to carry out a research study on the contextual meanings of everyday words in Physics involving mainly South African second language speakers of English. The majority of the learners in South Africa are second language speakers. It is imperative that such a study should be conducted involving second language South African learners to establish if they have difficulties with the use of everyday words in the physics context. Also, since there are no known studies involving physical science second language speakers of English in South Africa, the research intends to establish the existence and extent of this problem.

This new language of the science teacher will be another problem for the second language learners of English who have to first contend with attaining some degree of proficiency in the actual language of instruction. Learners have to deal with the *newly acquired meaning* of some everyday words when used in the Physics context (Oyoo, 2007). Becker (1993), in the same line of thought, agrees that the language *of science*, itself, is sufficiently unfamiliar to most secondary school students that it should be considered as a second language for them. Consequently, the difficulties encountered by learners in studying school science are a cause for concern because these affect their understanding of important science concepts (Cobbing, 2011; Howe, 2003; Johnstone & Sepeleng, 2001). In this study, the researcher considered the investigation of the difficulty of the science teacher's language as worthwhile area of research and an important contributor to discovering learner problems in learning or understanding physics concepts.

1.3. PURPOSE OF THE STUDY

It is on record that there are very few published research studies on the problem of language of teaching and learning Physics/science in South African schools. One notable review paper counted and analyzed all published studies in the area of language in science in South Africa and came to the conclusion that these studies only concentrated on proficiency in the language of instruction, code switching and development of indigenous languages in teaching and learning science (Venkat, Adler, Rollnick, Setati & Vhurumuku, 2009). The review thus showed that the area of language in science is grossly under-researched in South Africa. Jacobs (1989) studied word usage and misconceptions concerning first year (first language speakers of English) university students; Clerk and Rutherford (2000) focused on the 'language difficulty as a confounding variable in the diagnosis of misconceptions' using a sample of English first language speakers; Ferreira (2011) conducted a study on language for Life science (Biology) involving second language learners and advocated for code switching as a solution to helping learners to understand science content. These are the closest known studies in South Africa, to date, in literature. These few published research studies concentrate on the minority first language learners, apparently shunning the majority second language speakers of English. None of these studies involved the poor rural schools or the overcrowded and poorly equipped township schools concerning the language problem in South African science classrooms (Ferreira, 2011; Nhlapo, 1993; Venkat *et al.*, 2009). Further, there has been no focus on the words used in science teacher's classroom language in all these studies. Consequently, this study has explored the previously disadvantaged

economic areas in Johannesburg because such areas are representative of the majority of South African school-going children.

Consequently, the purpose of this study was to investigate the difficulties the South African learners encounter with everyday English words when used in Physics contexts. It targeted the second language learners coming from the previously disadvantaged areas (townships) of South Africa. It also investigated the teachers' influence in the use of these everyday words in the science classroom.

1.4. RESEARCH QUESTIONS AND SCOPE OF THE STUDY

The researcher identified the following research questions to guide this study:

- Do South African grade 11 and 12 physical science learners also encounter difficulties with everyday words when used in the Physics context?
- What are the learners' meanings and explanations to some everyday words when used in the Physics context?
- Do the teachers' explanations influence the learners' understanding of some everyday words as used in the Physics context?

The study focused on grade 11 and 12 learners of physical science and their teachers at five secondary schools in the city of Johannesburg.

1.5. RATIONALE OF THE STUDY

This may not be an entirely new study in the field of language problems in the science classroom. It may however, shed some light on the difficulties the learners experience in understanding the meanings of everyday words when used in the Physics/science context in South Africa, where teachers are usually on the rush to finish prescribed school science syllabi; they also use the science classroom language in ways that assume that their learners understand this language (Cassels & Johnstone, 1985). Consequently, it is hoped that the study will contribute to the pool of knowledge that may be used by the teachers of Physics/science and curriculum developers with regard to the type of language to be used in class, as well as in writing text books and examination questions. The study is therefore meant to improve the teachers' skills in the use of language during teaching, in other words the teacher's PCK as now explained.

1.5.1. *Pedagogical content knowledge*

Pedagogical Content Knowledge (PCK) according to Shulman (1986) is a body of knowledge that is a result of the influences of three domains, namely, pedagogical knowledge, knowledge about contexts and subject matter knowledge. The three domains of knowledge depend on each other to develop a good teacher. If a teacher has a high level of mastery of the subject matter knowledge in a particular topic, say of Physics, this does not imply that he/she is a good teacher (Bishop & Denley, 2007; Rolnick *et al.*, 2008). Such a teacher would need other special skills like organising the content to be taught, delivering lessons that are helpful to learners; skills to identify areas of possible misconceptions, and motivating learners. Loughran, Berry and Mulhall (2006) point out that teaching is not about delivery of content knowledge only. It is also concerned with acquiring improved skills of helping the learners. If the teachers are aware of their learners' limitations in the use of the instructional language of science, they would adopt a more positive role in assisting their learners. This is part of what PCK is all about, having the necessary skills or knowledge to assist learners in every possible way. The science teachers are key to the teaching and learning process of science because they "convey the ideas of science" using the science classroom language, practical demonstrations, discussions and metaphors (Matthews, 1998, p. 9). The use of language during the teaching process involves explanations that give meaning to abstract physics concepts, interpretation of experimental results and the theory presented in text books. All this is part of the teacher's PCK. The language of the physics textbook is part of the educator's classroom language as another source of the learners' idea of school physics (Oyoo, p. 170). Based on the role of language in all learning (Vygotsky, 1978), an educator who masters the science/physics classroom language is more resourceful to his/her learners. In this study, as in Oyoo (2009, p. 170), the term 'educator' will "embrace all the resources of school science knowledge to the learner".

That much said, this study seeks to establish and to explain whether grade 11 and 12 South African learners experience problems with everyday words when presented in the Physics context, an important area for teachers to improve their PCK.

This study in particular draws on the argued link between the process of acquisition of knowledge and the use of words. Language is very important for the teaching and learning process. It enables teachers to be understood by learners as well as to convey explanations and instructions to them. The text book writers and curriculum developers rely on the

language to convey important concepts, information and knowledge relevant to the science subject. The reason for the focus in words will be further discussed in section 2.6 as the conceptual framework of this study.

1.6. CHAPTER SUMMARY

This chapter has been an introduction to the study. It has elucidated the problems of the language of teaching and learning science as a contributing factor to poor performance in secondary school level examinations in physical science. It gives an insight into the research studies done in South Africa regarding the language problem. The underachievement in science examinations due to language difficulties in South African Schools has been argued. The research questions and purpose of the study have also been laid out. The rest of this report is structured thus:

Chapter 2 focuses on literature review and the conceptual framework that guided this study.

Chapter 3 provides an account of the overall research methodology and how the study was carried out. It also details the design and how the tools/ instruments are used, the piloting and sample used, the data analysis strategy and the actual data collection process.

Chapter 4 focuses on the presentation, analysis and discussion of results. This is where the collected data is presented in tables, pie and bar graphs concerning the learners' response to specific questions. The interview analysis for the learners and the teachers concerning the questionnaire responses are also presented in this chapter.

Chapter 5 is concerned with the conclusion of the research based on the findings of chapter 4. Reflections, limitations and recommendations/implications of the study are also presented in this chapter.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1. PREAMBLE

There is a substantial wealth of international literature that explores the issue of learners' difficulties with the science classroom language but in South Africa, it is very limited. In such literature, many researchers argue that the quality of communication is a vital factor in promoting the understanding of science concepts, particularly when the educator and the textbook are the major sources of information (Gardner, 1974; Muralidhar, 1991; Tao, 1994; Farrell & Ventura, 1998; Oyoo, 2009). In this chapter issues related to the nature of language, the South African language policy, the findings of relevant literature about the possible research-based evidence of the universal difficulty of the science classroom language are discussed. This provides a base for the arguments that research questions of this study sought to answer. The conceptual framework will also be discussed so that it can be used to guide the designing of the methodology of this study.

2.2. THE LANGUAGE PROBLEM IN RESEARCH

We rely on language to communicate with others, express ourselves, socialize, learn or teach and to interact with the reality around us (Ford & Peat, 1988). In addition, through language it is possible to build relationships and to be incorporated in social circles. According to Oyoo (2008, p. 103), "language is a system of sounds, meanings and structures with which we make sense of the world around us". In science education circles, language is very important for the teaching and learning process. It enables teachers to be understood by learners as well as to convey explanations and instructions to them (Cassels & Johnstone, 1985; Farrell & Ventura, 1998). The textbook writers and curriculum developers rely on the language to convey important concepts, information, and knowledge relevant to the science subject. At the receiving end, the language makes it possible for learners to understand the basic concepts, express themselves and to make meaning of the world around them. Language will therefore be a very important way of learning about concepts and situations in the science classroom. In the South African context, many learners come from rural homes, squatter camps and townships. Their surroundings and indigenous languages give them the picture of the world they carry into the science lesson. As an example, specific English terms like '*moon*', will mean three different concepts in isiZulu, like *month*, *traditional healer* or the *Earth's natural satellite* (Case, 1986; Rollnick, 2000; Howe, 2003; Makgato, 2007). Some

different concepts are not well distinguished due to the lack of a scientific register for some indigenous languages, like the names of different types of gases. The alternative conceptions and culture that these second language learners encounter in the physics or science (classroom) may complicate the process of communication and understanding of physics concepts (Strevens, 1976).

According to Muralidhar (1991), the quality of communication is vital in promoting the understanding of science, particularly when the major source of information for the learners is the textbook and the educator. The language of communication of the science textbook and the science teacher assumes that learners understand all the simple words. In many instances, the educators take it for granted that the language employed to define concepts, provide instructions and explain situations in science is self-evident and they fail to realise that what may seem simple and straightforward for them may be difficult and confusing to their learners (Farrell & Ventura, 1998; Muralidhar, 1991; Oyoo, 2009/2012). Lowe (2009) says that science is a new language to all learners of science where empirical evidence reveals that any changes in the meaning of simple words when used in the Physics context may present difficulties to science learners.

In this study, the researcher adopts the assertion and approach that the science educator is the most important resource in learners' effective understanding of science concepts presented by Oyoo (2008). Consequently, the science *educator's classroom language* will refer to the educator's talk (oral) and the language of the science textbooks (Oyoo, 2008). The difficulty of the language as used in science is discussed in detail later but first, a review of the components of language typical of the science classroom is provided.

2.3. THE NATURE /COMPONENTS OF THE SCIENCE CLASSROOM LANGUAGE

The science teacher's classroom language consists of the science *technical component* and the *non-technical component*. This will now be discussed in detail.

2.3.1. *The technical component*

The technical component refers to words that are specific to physics/science as a learning area (Oyoo, 2007, 2008). Other researchers (Gardner, 1980; Johnstone & Cassels, 1985) simply refer to them as 'scientific terms' or 'terms'. Originally, Gardner (1972, p. 7) asserted that the technical words in physics referred to physical concepts such as "mass, apparatus, force, etc." For Miller (1999) and Wellington (1994) in Oyoo (2009), the technical words are

everyday words that are conveniently and deliberately used as science words where they attain new or scientific meanings over and above their everyday meanings. These technical words have specific meanings in science that they are accepted and known by the community of scientists to represent science concepts.

Lowe (2009, p. 3) has further subdivided the technical component into two categories, namely 'mixed' (sub-technical and semi-technical) and 'specialised' technical terms. He refers to the sub-technical and semi-technical terms as words which are commonly used in ordinary situations and in precise science concepts, for example, *cell* and *force*. These words have specific scientific meaning yet are derived from the English language vocabulary, where they may have other meanings. The specialised terms are technical words used only in science, ideally having one meaning, for example, *proton*. Lowe further states that most specialised words have no meaning outside science.

Since the technical terms are everyday English words used in a specialised way to name science concepts, then they are bound to have different identities, namely "conceptual, linguistic and cultural" (Oyoo, 2009, p. 170). They are used to create a new language, to represent the culture of the science community and to represent science concepts. Possibly, failure to recognise the three identities of such science terms in the process of teaching and learning is a contributor to the difficulty of the science classroom language. Studies conducted by Cassels and Johnstone (1985) show that technical words of science presented problems of familiarity, however, the learners were able to cope (to some degree) with the use of these words. With a large sample of 30 000 learners between the ages of 11 and 18, Cassels and Johnstone investigated word understanding by using multiple-choice items with 95 words. These items consisted of common words that could be encountered in the science lessons. The results of the investigation were that 70% of these words were poorly understood by the lowest age group whilst 70% of the 15 to 16 year olds had difficulties in understanding 21 of the 95 words presented to them. As a recommendation, Cassels and Johnstone suggested teachers should set aside more time for explaining and discussing the meanings of the words with their learners.

2.3.2. *The non-technical component*

The non-technical component is the main part of the classroom language. According to Oyoo (2010) this forms part of the science educator's classroom talk that is also used as the science textbook language. This is the science teacher's classroom talk which is the conveyor belt of

meanings, instruction, commands, explanations and elaborations during the process of teaching and learning. Ford and Peat (1988) consider this passive role of language as a vehicle whereby meaning and information are conveyed from the educator to the learner. Cassels and Johnstone (1985) refer to this component as consisting of the terms that have one or more meanings in everyday language but has precise, and at times, different meanings in a scientific context. Examples include words like *appropriate*, *estimate*, *valid* and *random*. Gardner (1972, p. 7) gives examples of such words (in italics) when used in sentences as follows: "…gas molecules display *random motion*; we may *predict* their behaviour from *theoretical* considerations…*neglecting* the actual volume of the molecules…" This implies that the non-technical terms in italics are key words in the related sentences concerning the concept of the gas 'molecule', a technical term. Terms like these are referred to as 'the non-technical words in the science context' by many education researchers (Gardner, 1972; Cassels & Johnstone, 1985; Farrell & Ventura, 1998; Oyoo, 2007; Lowe, 2009).

The non-technical component can be divided into three categories. The first category consists of everyday words/non-technical words used in the *Science context*, the second one is for the *metarepresentational* and the third is about *the logical connectives* (Oyoo, 2007). The everyday words in the science context are straightforward with examples mentioned in the previous paragraph.

The 'metarepresentational terms' refer to the *thinking* terms, which are words that are concerned with learning like *define*, *investigate*, *classify* and *deduce.* Lemke (1990) also asserts that the metarepresentational terms are associated with 'talking science'. These terms are further classified into two groups, namely the metalinguistic words and the metacognitive words. Wilson (1999, p. 1069) refers to the "metalinguistic verbs as words which assume the place of the verb to *say*, for example, 'define', 'explain' and 'predict' whilst the metacognitive verbs are words that assume the place of the verb to *think*, for example 'infer', 'calculate', 'observe' and 'analyse'. These are the "key words" or "operative words" (Oyoo, 2008, p. 106) that form part of examination questions giving the candidate the necessary instructions. Also, Bulman (1986) says that these are the words that constitute the content, structure and emphasis in examinations. For a learner to understand the needs of the examination questions and then produce the correct answers, he/she must have the correct knowledge of the meanings of metarepresentational terms used. Participation in fruitful

science classroom discourse by learners is largely dependent on the complete understanding of such terms.

The 'logical connectives' refer to linking words in the science classroom language, for example, *therefore, consequently* and *since* (Oyoo, 2007). Gardner (1977a, p. v) refers to the logical connectives as "words or phrases which serve as links between sentences or between prepositions within sentences, or between a preposition and a concept". These are the words whose functional value or importance is evident in debates or essays writing to "….link theory to explanation, hypothesis to experiment and experiment to findings in science (Fensham, 2004, p. 202). The logical connectives are also important for the learner's participation and understanding of the educator's science talk and the science learning processes. This is because sentences and concepts in the teacher's classroom talk are linked with such logical connectives.

2.4. FINDINGS IN DIFFERENT STUDIES ON THE LANGUAGE PROBLEM

2.4.1. *Difficulty of the words in the technical component of the science classroom language*

Driver, Guesne and Tiberghien (1985) conducted a study on the learners' understanding of technical words, and identified some general features that characterize the children's thinking about physical science phenomena. These included the fact that learners do not always understand many concepts like *thermal conductivity*, *action of a force*, *resultant motion*, and *pressure* in problem situations as expected. In their findings, they concluded that science learners have a tendency of initially basing their reasoning on observable features in a problem situation. To address this problem, they suggest that it is vital for science teachers to lead pupils to "consider phenomena and experimental situations in a particular way – to learn to wear the *scientist's spectacles*" (Driver *et al.,* 1985, p. 193). They also considered that learners' thinking is sometimes context dependent. These authors are simply pointing to the fact that the learners' understanding of science depends on other factors, besides fluency in the language of instruction.

In another study by Lynch, Benjamin and Chapman (1979), the comprehension of technical words like *mass, element, length, liquid, proton, etc* was tested using Tasmanian16 year olds (Australia) who totalled 1635 in number. Multiple choice questions were used to test the understanding of these concept words associated with the theme "nature of matter". The results revealed a thorough misunderstanding of these technical words. About 60% of the

learners failed to select the correct definition of the concept word *electron,* 50% could not choose the correct definition of the word *mixture* whilst 30% failed to identify the definition of the word *solid*.

Jacobs (1989) writes in a research using first year English first language speaking students at the University of Cape Town, South Africa, that students had inadequate grasp of some Physics terms that lecturers took for granted in many instances. The students' *perceived* understanding of some common Physics terms was different from their *actual* understanding of these terms. She assumed that the English vocabulary used in Physics can be classified into three groupings, namely standard "lay" vocabulary, specialist terminology and standard vocabulary used with specialist meaning, e.g. 'point' and 'frequency'. The third category was a cause for concern in that the everyday use or familiarity of the words easily leads students to think that they knew or understood their use, yet it was not. In the study, Jacobs (1989, p. 399) came to a convincing conclusion that the "language of Physics classroom" is not dependent on the fluency of the student in the language of instruction. The study did not, however probe second or third language speakers doing the same course; the study therefore did not establish the place of proficiency in the language of instruction as a factor of learning in science. In addition, the researcher did not consider the contextual meaning of certain terms in the language of physics texts or classroom.

The Clerk and Rutherford (2000) study, conducted in South African with a sample of high school students studying physics intended to unearth the hidden fact that it is the words used in the language of instruction (English), not misconceptions, that actually create difficulties and confusion to students trying to understand Physics concepts. This study (that used as a sample, first language English learners) established that language remains a *confounding variable* in the diagnosis of misconceptions in school Physics. It was revealed in this study that regardless of whether learners are first language users of a language, the difficulties encountered with the use of language contributed to poor performance in national examinations.

In these studies, the researchers used first language speakers of English and they found that the technical words were problematic to learners of science. However, Cassels and Johnstone (1985, p. 1) they asserted that the problem "lay not so much with the technical language of science, but in the vocabulary and usage of normal English in a science context". Tao (1994, p. 322) also supported this observation by mentioning that "the problem goes beyond the

technical words considered to be essential for studying science". The next section of this study will look at the non-technical component and its difficulty in the science classroom.

2.4.2. *Difficulty of the non-technical component of the science classroom language*

The use of non-technical words in science education is the main focus of this study. Doctor Paul Lesley Gardner working at Monash University in Melbourne, Australia initiated interest in word understanding research studies in the early 1970s. In 1971 Paul Gardner conducted the pioneer study in Papua New Guinea using a sample of secondary school learners doing Forms 1 to 4 (grades 8 - 11equivalent in the South African system of education). These learners were second language speakers of English, the language of instruction. He studied the accessibility of 599 common English words (non-technical terms in the science context) like *disintegrate, spontaneous* and *random* by administering multiple choice tests to the learners. The results were astounding with 81 – 90% of the Form 1(Grade 8) learners in the sample failing to correctly score the words. The study was later repeated using the same design in Victoria, Australia (Gardner, 1972) and then in the Philippines (Gardner, 1976) for secondary level learners doing Forms 1 to 4. Working under the Australian Science Education project, he used over 7000 pupils in 39 different schools to test their understanding of more than 600 words. The Australian sample consisted of first language speakers of English, and, the Philippines sample consisted of second language speakers of English as the language of instruction. Similar trends of poor understanding of non-technical terms were revealed in both studies. However, the participants from the Philippines performed poorer than the Australian participants, implying that the second language speakers of the language of instruction encounter more difficulties with the use of non-technical words than the first language speakers. Gardner's studies therefore revealed that common everyday words used by science educators in the classroom were poorly comprehended by the pupils. This finding triggered a flood of investigations in this area in the years that followed (Farrell & Ventura, 1998). Many of these studies were replicating Gardner's initial design in different situations,) save for a few like Farrell & Ventura (1998) and Oyoo (2000).

The "most rigorous and follow up studies between 1975 and 1979 was the investigation carried out by James Cassels and Alex Johnstone" (Farrell & Ventura, 1998, p. 243). In the the investigation, 25000 participant learners (Scottish and English) were involved. The researchers wanted to investigate the observed effects of rephrasing a number of multiple choice questions, replacing traditional non-technical terms like *fused* with *melted* and,

pungent with *chocking*. The modified test papers were then administered, revealing a significant improvement in the participant learners' correct scores. In another study conducted by Johnstone and Cassels (1985), their findings point to the fact that the understanding of a word is largely dependent on its *context* and *connotation.* It becomes a problematic situation when both learner and educator assume that they know the meaning of a particular word and each assumes that the other shares the same meaning. In their study, Johnstone and Cassels also concluded that for learners, a word in a scientific context was harder to understand than the same word in a non-scientific context. Examples of expressions included in some questions like *naked flame, liberating gas* and*, preparation of a gas* are difficult to understand than the corresponding ones in daily situations like *naked body, liberating prisoners* and *preparing a team for a game* (Johnstone & Cassels, 1985, p. 11). This further evidences the fact that learners bring in the terms and words in their existing vocabulary or the everyday context to the science classroom only to discover that they are using a different language.

Bulman (1986) argues that for most pupils, reading in science is probably one of the most challenging demands made on them throughout their secondary schooling. The reasons why science is so difficult must begin with the difficulty of the language of science itself. The science classroom language strives to be precise within the scientific context. Therefore, the vocabulary of science is an obstacle in learners' path of understanding science concepts. This is reason for creating science dictionaries (Bulman, 1986, p. 21). At times, the sentence structures become too long and confusing to the novice or unskilled science reader like a learner.

According to Welford and Bird (1995), the wording of examination questions plays a significant role on the learners' understanding and performance. In their study, following Cassels and Johnstone's earlier research findings, they focused on the wording of multiple-choice questions where they showed that the performance of the pupils improved slightly with the use of simplified language. They used two samples of participant learners in their study consisting of 100 British learners (English first language) and 100 Botswana learners (English second language). The findings were similar to those obtained in Cassels and Johnstone's study for the Botswana participant learners (English second languages). There was an improvement in their number of correct scores. However, this did not affect the performance of the British learner participants, showing that second language speakers face

more difficulties in understanding non-technical word meanings. The other problematic area of scientific English was in use of *logico-grammatical terms* (e.g. consequently, whenever and therefore) and the l*ogical connectives* (e.g. conversely, respectively and further). They then targeted such areas in order to change and simplify the multiple-choice questions used in their research. This restructuring of questions depended on three factors, "namely, the reduction in length of the questions used; the change in particular words and, the removal or omission of extraneous information" (Welford & Bird, 1995, p. 396). The researchers assumed that the first two had obvious language effects. They concluded that second language students of science could perform better with the use of simplified language of instruction. However, they did not consider the effects of contextual meanings of certain words.

There are two studies (Farrell & Ventura, 1998 and Oyoo, 2000) that focused on different categories of learners at different schooling levels, like a sample from both first and second language learners simultaneously drawn from different countries. Nevertheless, the trends and types of findings in all the studies have been very similar. Irrespective of gender and proficiency in the language of instruction, the learners encounter difficulties with everyday words presented in the science context.

2.4.3. *Difficulty of the logical connectives in the science classroom language*

Paul Lesley Gardner (1980, p. 224) defines a logical connective as a "term which serves to link a phrase, clause, or sentence to another clause or sentence". In the only major study conducted so far, Gardner (1977a) found that the use of logical connectives in the science classroom language also complicated the situation for the learners studying science. His research involved a sample of 171 first language English students in Forms 1 to 4 (grade 7 to 11 equivalents) using 25 logical connectives. Gardner (p. 166) used the logical connectives to make two kinds of multiple choice items, namely sentence completion and gap filling to produce a 50 item test. In the study, Gardner arrived at the conclusion that the logical connectives used in the science classroom language made it difficult for students to understand science.

2.4.4. *Difficulty of the metarepresentational terms in the science classroom language*

There are no published studies in literature that deal with the difficulties the learners encounter with the use of *metarepresentational terms* (Oyoo, 2008; 2011). Such terms

include words like *describe*, *explain*, *observe*, *comment*, *define* and *distinguish*. However, there is some evidence that such words cause difficulties in learners' understanding of examination instructions and questions. Some reference to this problem is made by some researchers in other studies, particularly the confusion caused by the two everyday words *observe* and *describe* (Oyoo, 2008; Peacock, 1995). Evidence may also be obtained from examiners' reports concerning previous National Senior Certificate examinations (NSC) in Physical science (Appendix F). According to Tao (1994), this component of the science classroom language is confusing to learners as they learn science concepts.

2.4.5. *Science teachers' awareness of the difficulty of everyday words as a contributing factor*

As evidenced by the literature reviewed, many research studies have been conducted in the area of difficulty of the teacher's classroom language in science since their championing by Gardner in the early 1970s. However, as mentioned in some sections of this chapter and the number of studies reviewed in this study there are very few known studies in this area in South Africa for English second language learners of science.

In all these studies, the findings reveal poor understanding of the non-technical terms when used in the science context by learners. Consequently, there is a high probability that teachers are not aware of this problem or they choose to ignore it. Studies on the science teachers' use of language of instruction in the classroom as a source of difficulties to the learners and, the science teachers' awareness to this problem are rare (Yore, Bisanz & Hand, 2003; Yore & Treagust, 2006; Oyoo, 2009). In one of his latest studies, Oyoo (2009) concluded that learners indeed have trouble with the English words (as a language of instruction) in the teaching and learning of Physics/science. The study was conducted in Kenya, a country in sub Saharan Africa, involving mainly science teachers and students. The study investigated the physics teachers' use of the language of instruction and the difficulties learners encounter when using *every day (common) words (English) in Physics/science context*. In that study, Oyoo came to a conclusion that learners encountered difficulties with the use of the science class room language but the teachers were not aware of this in many instances. This shows some similarities with the researcher's study conducted in South Africa involving learners and their teachers. We concur in that the difficulties encountered by learners in studying school science are a cause for concern because this affects the overall pass rates in the science subject. It is imperative to identify the root cause of such problems, in order to help the

learners to understand science concepts, answer questions properly and to prevent the formation of misconceptions.

Teachers are usually concerned with syllabus coverage, ignoring language issues. Muralidhar (1991 p. 254), concluded that the poor scores in science examinations due to science classroom language is a result of teachers who "take it for granted that the language used to define terms, express rules or explain terms is self-evident to learners". In a study conducted on the role of language in teaching science to English second language, the author observed how the teachers used terms like *classify* and *describe* in questions written on the board for learners to answer without bothering to explain their meanings. The learners produced strange answers due to the fact that the teacher was not explains such non-technical terms. It is important that this language must be understood by the learners, taking into account their general background and level of schooling.

In this study, the researcher shares the same view with other researchers that if teachers explain the meanings of the non-technical terms to learners, this may go a long way in assisting learners to understand Physics concepts (Oyoo, 2007/2008). The learners may be failing to understand what examiners are expecting in particular. The learners may misinterpret situations owing to the use of non-technical terms in a particular context-not as a result of lack of content knowledge of Physics. Furthermore, the researcher is of the view that the learners may be in a better position to understand Physics concepts if they realise that everyday words attain a different meaning depending on the context they are used. Consequently, teachers ought to be aware of the difficulties that the learners encounter with the contextual change in meaning of everyday words when used in Physics in order to conscientise the learners. If learning using the *language of the science classroom* is not easy for the native speaker of the language of instruction, how much more is it for the non-native speakers? This is precisely why the teacher has to be certain that he/she is communicating with the learners, not complicating the situation further (Cobbing, 2007). Many researchers, used samples of first language and/or second language learners as their research samples that the non-technical terms are problematic (Oyoo, 2007, 2008, 2010). Some of these researchers like Johnstone and Selepeng (2001) used samples of both first and second language learners for comparison and they arrived at the same observation that this component is problematic

Internationally, the research studies have attempted to show that all the three non-technical component categories of the instructional language used in science are generally difficult to

all learners regardless of their gender, and linguistic or cultural backgrounds (Oyoo, 2008, 2009). It should therefore be expected that "learners' understanding of the meanings of all words in this language when used *as* science words and/or *in* science context would result in enhanced students' understanding or internalisation of the concepts taught" (Oyoo, 2009, p. 171). The science classroom language is different from the language of instruction for both first language speakers and second language speakers (Tao, 1994). In a scientific context, the words are more precise in meaning than in general situations.

The literature reviewed show that learners encounter difficulties with the use of the science teacher's classroom language in many countries, particularly for the second language learners of English. The present study also intended to investigate this problem for South African children doing Physics. Now that the two components of the teacher's classroom language have been reviewed, the next sections will briefly look at the South African language policy as enshrined in the post-apartheid era constitution, and thus present the reason why this study was relevant to the South African situation.

2.5. THE LANGUAGE AND THE SOUTH AFRICAN LANGUAGE POLICY

There are 11 languages that were granted official status out of the 25 spoken in the country. The Constitution of South Africa (1996, articles 21 and 23) states that everyone has a right to basic education in the official language of their choice, and, that every citizen of South Africa has the right to use the language of his or her choice as well as to practise his/her culture in line with the Bill of rights. This was intended to help the learners to understand concepts in their own language.

In 2003, the Department of Education in South Africa launched a language policy framework based on the constitution of the country, acknowledging that this is a multilingual country. It emphasized that all the official languages should enjoy parity of esteem and must be treated equitably. The aim of this principle was to retain the learner's home language for learning and teaching as well as to encourage learners' acquisition of additional languages. Strangely, some deep-seated mistrust and fear that the home language education would lead to impoverishment, social, economic, and political disempowerment has led to the majority of South African learners choosing English as the preferred language of instruction (Wet, 2009). This trend has side lined most of the indigenous languages and this means that the majority of South African learners use English as a second language in schools. This would make us to expect South African learners encounter more difficulties with the language of the science

classroom. This is argued because many studies in other countries have proved that second language learners experience more difficulties with the use of the science teacher's classroom language. This study intends to establish whether South African learners also encounter such difficulties.

The present study was thus conducted in such a complex background regarding the medium of instruction and language policy framework. The next section, the researcher analyses the conceptual framework guiding this research study in the light of the findings of other studies concerning the difficulties the learners encounter with the technical and non-technical terms.

2.6. THE CONCEPTUAL FRAMEWORK

The most notable contribution of Vygotsky (1978) in relation to the focus of this study is the role of language in concept formation and development. Vygotsky asserts that there is a dynamic relationship between language and thought. This implies that the concepts that learners have to master cannot be fully realized or understood until they are represented in words (Tao, 1994). Vygotsky further points out that it is through the use of cultural tools of society like *language*, that the teachers intervene during the process of learning. Vygotsky (p. 81) uses the concept of "Zone of Proximal Development" (ZPD), which refers to the situation when the learner cannot solve a problem alone but can be successful under adult guidance or in collaboration with a more advanced peer so that he acquires and integrates the new knowledge into his existing knowledge. For example, in Physics, a grade 12 learner may have knowledge of simple application of the equations of motion in one dimension like '$v^2 = u^2 + 2as$' studied in the previous grades. This implies that the learner can independently solve simpler calculations that involve equations of linear motion because this is below his/her ZPD. However, more complex Physics tasks involving two-dimensional (2–D) kinematics like '$x = (2v^2 sin2\Theta)/g$' are above the ZPD and might need assistance from the educator or another gifted peer member (Vygotsky, 1978). When a Physics educator assists a learner in developing an understanding in the calculations of 2-D projectile motion, he is scaffolding him from not being able to understand and calculate, to being able to understand and calculate. The Physics educator should provide instructional assistance (simplified language) or scaffolding for the learner during the mathematical calculations of 2-D projectile motion. In other words, the Physics educator guides or supports the learner's understanding by building on this learner's prior knowledge. This idea is imported to the new South African curriculum document where the educator assumes the position of a facilitator or mediator of

the process of learning. Consequently, the literature reviewed in this study views the teacher as the cornerstone to the use of appropriate language of instruction for learners to understand physics concepts. According to Oyoo (2009, p. 170), this is the teacher's science classroom language. This becomes the most important resource in the learning process and communicates with the learners using understandable language. It is at this juncture that one may ask: 'Is the language used by the Physics teacher understandable to the learners?' As an example, when a physics educator assists a learner in developing an understanding of difficult physics concepts; he/she uses *language* by scaffolding the learner from a lower level of understanding to a higher level of understanding. This idea is also employed in the new South African curriculum document in which the educator is to assume the position of a facilitator or mediator of the process of learning (CAPS, 2008).

The language of the teacher depends on *words* which are used to construct knowledge. According to Oyoo (2012, p. 854), this implies that "the key to understanding a 'subject' is to understand its language…and what we call a subject is its language". The way of understanding and knowing cannot be separated from the symbols or *words* used. Also, Hodson (1999, p. 242) in Oyoo (2012, p. 854) asserts that "whatever is known is inseparable from the …*words* in which the knowing is codified". This ultimately leads to the cornerstone of this study, the pragmatic perspective on language by Wickman and Östman (2002), asserting that "the meaning of a word is its use and function in a specific activity" (Oyoo, 2010, p. 204). Assuming the Vygotskian stance, any learner with poor language skills will be handicapped in concept development and will suffer from misinterpretation of words (Tao, 1994).

The teacher would then be in a position to easily explain the meanings of words that assume new meanings in the Physics context using the learners' native language. This is especially argued based on the Sapir-Whorf hypothesis about language where it is assumed that one's thoughts and behaviour are determined or influenced by the language and culture. The language one speaks determines the world around him/her (Orwell, 1948). This implies that the learner brings into the classroom what he/she has already acquired in the outside world. The learner will then begin a journey of learning science by comparing what he knows with the new *science classroom language.*

It was mentioned earlier in this chapter that the educator's *classroom talk* is important in achieving meaningful learning in the science classroom. Consequently, the use of language

cannot be avoided in effective teaching (Oyoo, 2010). According to Matthews (1998, p. 123), educators try by all means possible to explicitly explain 'concepts and operations' by the use of a variety of linguistic approaches like metaphors, demonstrations and debates. As a result, the educator talk or educator language may include the language used in the science text books as resources and this is an important source of knowledge for the learner. The science teacher's classroom language was classified earlier as comprising of the *technical component* and the *non-technical component*. According to Oyoo (2009, p. 171), it follows that the learners' understanding of the meanings of all words in this language "when used *as* science words…*in* the science context would enhance their understanding or internalisation of the concepts taught". The correct use of this language in the learning process is very important because the meanings of everyday words when used in the science context may be a source of difficulties to learners in learning science.

The literature reviewed in this section views the teacher as the cornerstone to the use of appropriate language of instruction for learners to understand physics concepts. According to Oyoo (2009, p. 170), this is the teacher's science classroom language. This becomes the most important resource in the learning process and needs to communicate with the learners using understandable language. This means that the language used by the physics teacher should be understandable to all the learners. This is guided by the third research question of this study: *Do the teachers' explanations influence the learners' understanding of some everyday words as used in the Physics context?* In chapter 1, it was mentioned that the teachers' PCK involves the teacher's need to understand that teaching is not about delivery of content knowledge only but that it is concerned with acquiring improved skills of helping the learners. One of these skills is to use the language of teaching and learning in a correct way in order to assist the learners.

2.7. CHAPTER SUMMARY

In this chapter, the researcher briefly reviewed the language problem and other language issues within the body of knowledge in literature. The literature reviewed has shown that there is indeed a problem with the science classroom language and that the difficulties the learners encounter are independent of their proficiency in the language of instruction.The conceptual frame work guiding this study was also presented. The next chapter will now explore the research design and methodology of this study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1. PREAMBLE

This chapter describes the research methodology which was employed to establish the existence of difficulties science learners experience when they use of everyday words in the science context. It includes detailed descriptions of the research design employed, the methods used, the sample, the data collection instruments, the pilot study and the data analysis procedures that were implemented.

3.2. THE RESEARCH DESIGN

According to McMillan and Schumacher (2010) the purpose of a research design is to describe the plan for the selection of the target population, participants, methods of data collection, methods of data analysis and how the data is to be presented in order to answer the research questions of the study. Ultimately, its main purpose is to enable credible results to be obtained from the study.

Since the purpose of this study was to investigate learners' difficulties with the use of everyday words in the science context, a mixed methods approach that yields both qualitative and quantitative data was adopted. This is due to the fact that the adopted research design has some borrowed quantitative and qualitative aspects, where a survey design (explorative and descriptive) was followed. This research approach enabled data collection from physical science learners and educators who depend on the science classroom language for the process of teaching and learning in schools. Gay, Mills and Airasian (2006) assert that data obtained using this design approach is more trustworthy and reasonable.

3.2.1. *The mixed methods approach*

The mixed methods research started in the 1960s when researchers experimented on merely merging quantitative (e.g. survey) and qualitative (e.g. case study) research methods in the same study (Leech & Onwuegbuzie, 2009). This concept of combining the two separate approaches (quantitative and qualitative) in a single study then gained momentum and popularity over the years to become what it is today, a stand-alone approach (Creswell, 2012). The success of this methodological approach is based on the premise of merging the strengths of quantitative and qualitative approaches. Consequently, the results that can be

obtained through such combined methods may enrich and strengthen the understanding of the phenomena that is being researched about. This also provides a powerful approach which gives answers to questions that are difficult to answer by using a single method (McMillan & Schumacher, 2010; Opie, 2010; Creswell, 2012).

Qualitative research starts from the perspective and actions of the participants studied, while quantitative studies typically proceed from the researcher's ideas about the dimensions and categories, which constitute the central focus (Bryman, 1989). Hence in this study, mixed methods design was selected to establish the existence of science classroom language problems in grade 11 and 12 physical science learners in South Africa, to have a better understanding of the source of these problems and to establish whether teachers' explanations have any influence in their learners' understanding of the contextual meanings everyday words used in the language (Farrell & Ventura, 1998; Gay *et al.,* 2006).

3.2.2. *The Case Study*

The case study is 'an in-depth analysis of a single entity' (McMillan & Schumacher, 2010). According to Yin (1984) in Gable (1994), the case study approach refers to a grouping of methods that emphasises the qualitative analysis. The information (data) is obtained using "a small number of organizations through methods such as participant-observation, in-depth interviews, and longitudinal studies" (Gable, 1994, p. 112). McMillan and Schumacher (2010) say that the case study looks at a case where multiple sources of data may be found in the setting. As an example, the case may be a set of individuals that are bound in a particular place, setting and time. The researcher is permitted to identify the case and then establish the boundaries (McMillan & Schumacher, 2010). The main objective of the case study approach is to understand the issues or problems that are under investigation. It also creates a platform for asking "penetrative questions" as well as to capture important information concerning "organizational behaviour" (Gable, p. 112). However, any conclusion obtained may be applicable to particular target population under the study and this may not be generalised. Creswell (2007) asserts that in order to judge the merits of a case study, this necessitates the establishment of sufficient and appropriate information. This enables others the judge "the analysis in the context of the setting" (Dillon & Wanjiru, 2013, p. 14).

The case study has some weaknesses and Kerlinger (1986, p. 348) identifies and groups three types of weaknesses of the case study or qualitative research and these are, firstly: the inability to manipulate independent variables; secondly, there is a possibility of

misinterpretation; thirdly, randomising is not guaranteed. However, Lee (1989) in Gable (1994, p. 14) in proposes four weaknesses of the case study research and these are concerned with the lack of "Deductibility", "Controllability", "Repeatability" and "Generalizability", where the latter two limitations stem largely from the aforementioned lack of power to randomize.

In this study, the researcher chose the South African *case* that was characterised by a multilingual setting of learners coming from economically deprived communities called townships "in order get an in-depth insight into the challenges and a rich holistic analysis" of the science teacher's classroom language (Dillon & Wanjiru, 2013, p. 16).

3.2.3. *The survey*

A survey takes general views of, scanning and examining opinions, beliefs, attitudes, values, characters, demographics, habits, desires, ideas, and other types of information (McMillan & Schumacher, 2010; Gay *et al.*, 2006). Bell (2005, p. 13) says that the aim of a survey is to describe the incidence, frequency or distribution of characteristics of a particular population. In McMillan and Schumacher (2010) surveys may be used to investigate the relationship of cause and effect for variables or current status when gathering data from population members.

There are several other reasons why the survey method was used in this study. Firstl, survey method is better suited for determining levels of knowledge among learners (McMillan & Schumacher, 2006; 2010). It is suited to obtain information on people's attitudes, beliefs, values habits and *ideas*, to mention but a few. Cohen, Manion and Marrison (2000) assert that a survey can be used to provide descriptive, explanatory and inferential information concerning a phenomenon. In this study, the researcher would collect descriptive or explanatory ideas about learners' ideas on the meanings of everyday words. Also, according to McMillan and Schumacher (2010) a survey can be used for a target population that is wide but using a small carefully selected *sample*. Positive or negative points concerning this target population can then be built using a survey. Bell (2005) asserts that in a survey, all respondents may be asked the same questions in, as far as possible, the same circumstances. This is a useful point supporting this research's intentions, where the same questionnaire items are used for all learner participants. Another advantage of the survey approach is that it uses a population sample to obtain data whose findings may be generalised, but to a limited

extent. Lastly, the survey approach is flexible, facilitating a quick and economical way of collecting data from geographically dispersed areas or individuals (Creswell, 2012, p. 376).

The surveys have weaknesses. This is noted by Pinsonneault and Kraemer (1993) who assert that surveys are particularly not suitable in a situation where historical context of phenomena is needed. Bell (2005, p. 55) also observed that bias may occur either where intended participants fail to respond or produce responses that are inadequate in the nature and accuracy. Another weakness emanates from deliberate misreporting of behaviours by the participants in order to "confound the survey results or to hide inappropriate behaviour". In other cases, the participants may be unable to make an accurate self-assessment of their own behaviour or have limited memory of the circumstances that contribute to how they behave.

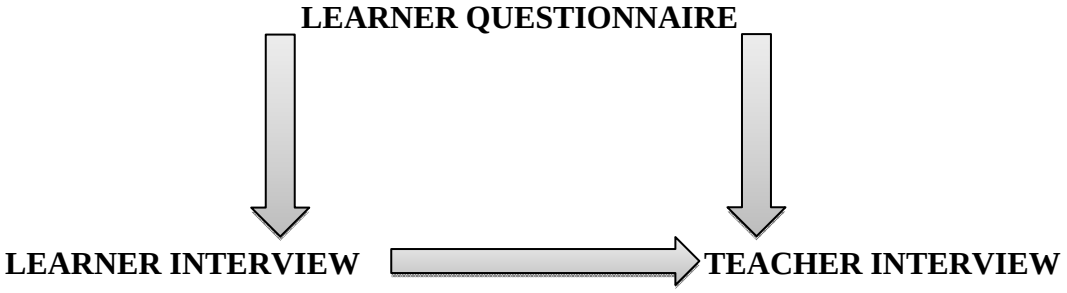
After analysing the strengths and weaknesses of the survey method, this study followed this approach because it provided evidence that made it possible to gain insight into the existence of difficulties with the use of everyday words by high school learners. It also enabled the researcher to obtain information concerning the ideas and opinions of science teachers and their learners themselves about the words used in the science classroom language. This research is a case study referring to South Africa. Even though smaller samples may not be representative of the entire population (Bell, 2005), this study has a big enough sample involving 5 schools, 105 learners and 5 teachers. This is a big sample by acceptable standards (Gable, 1994; Bell, 2005; McMillan & Schumacher, 2010; Creswell, 2012). The sample size was dictated by financial and logistical issues as explained later in 3.5, the sampling section.

3.3. DATA COLLECTION METHODS

This study focused on the difficulties the learners encounter with the science classroom language in some South African schools - the use of everyday words in the physics context in particular. As a result, one of the researcher's intentions was to gather evidence to bring to light the evidence or existence of this problem in some schools where there is a fair representation of different communities. The data collection methods used in this study was the *Questionnaire* and *Interview*. The study used a questionnaire to unearth the quantitative evidence to answer the first question of the research: *Do South African grade 11 and 12 physical science learners also encounter difficulties with everyday words when used in the Physics context?* The other two research questions were answered by interviews of the learners and the teachers, the qualitative part of the research. According to Vithal and Jansen (1997), data obtained from a variety of instruments helps in creating the much needed checks

and balances for reliability and validity. The questionnaire with learners, interview with learners and interview for educators is a triangulation which is a way of cross validating data sources and data collection strategies (see Figure 3.1). Mathison (1998) asserts that triangulation is a strategy to collect evidence that will be helpful in explaining social phenomenon as well as to bring convergence between different data.

FIGURE 3.1: Triangulation



3.3.1. *The Questionnaire*

Johnson and Christensen (2008, p.170) describe a questionnaire as a self-report data-collection instrument that each research participant completes as part of a research study. McMillan and Schumacher (2010) assert that it is the most popular technique for obtaining data from participants because it is considered to be relatively economical. In this study, it was assumed to be convenient and economical for obtaining data from a large sample of learners of science in different schools. The questionnaire has other numerous advantages, which is the reason why it was considered the best research tool for this research. It is simple to administer the questionnaire such that less time would be used in the already overloaded school curriculum of the teachers and learners. It may be used along with other data collection methods like interviews in the same research study. Also, it is imperative to administer properly designed, authentic and valid questionnaires so that the data obtained is more accurate and useful (Gay *et al*., 2006; Opie, 2010). This was achieved by reviewing many similar studies (Gardner, 1972/1975; Cassels & Johnstone, 1980/1985; Driver *et al.,* 1985; Muralidhar, 1991; Tao, 1994; Farrell & Ventura, 1998; Oyoo, 2008/2009/2010) in order to compile an authentic list of non-technical terms that would rhyme with this study's objectives.

3.3.2. *Questionnaire design*

The Questionnaire consisted of multiple choice response items with non-technical words adopted from a list of 30 words used in the science classroom language compiled by Dr Samuel Ouma Oyoo and, other similar lists used by other reputable researchers like PL Gardner (1972), and Cassels and Johnstone (1985) with 95 words. Oyoo has published a number of studies in the area of the science classroom language. It should be noted that the Cassels and Johnstone and the Gardner original lists of words were not directly suitable for this study because they had words used in the chemistry and biology sections of science. Some of the words are no longer popular with current science textbooks, for example the word *pungent* is rarely used in current textbooks in South Africa. Tao (1994, p. 324), advises researchers that even though it is important to use adopted lists that use the original words for authenticity and validity, an "indigenous" list of words that suit local conditions is much better.

Consequently for this study, these lists of words were scrutinised and sifted by the researcher in order to choose the words suitable for the physics curriculum in South African only. It also appears that the different lists had many similar words that were extensively replicated in many similar studies mentioned in the literature review section, for example, words like *appropriate*, *estimate*, *valid, spontaneous, disintegrate, define*, *displace*, *generate* and *negligible*. These are everyday words and meta-representational terms in the English vocabulary that change their contextual meaning in science (Cassels & Johnstone, 1980/1985; Oyoo, 2008). This is why the researcher solicited for expert advice directly from Dr Oyoo in selecting the final 25 multiple choice response items from the original lists to suite the framework of this research study. The final response items selected were meant to be simple, straightforward and suitable for Grade 11 and 12 learners studying Physical science in South Africa as well as being relevant to the objectives of this study. As a criterion to determine the suitability of a word in the South African context and school level, the word was to be found in the popular science textbooks or science curriculum for the local and current grade 11 and 12 science curriculum like *Siyavula Physical Science* textbook for grades 10 to 12 (2012) and *Successful Physical Science* textbook for grades 10 to 12 (2012).

This process is similar to what P.L. Gardner (1972) did in the research to identify important non-technical words used in the pioneer Papua New Guinea study. The words were first

identified, and then multiple choice items were written, tried and revised by a panel of science teachers and science researchers.

Consequently, in this study, after selecting the words, sentences were then constructed to create questions using each of these words in order to create the "context" together with 4 possible answers.The wording of all questions in the items was such that it allowed the learner to think around a particular underlined key *word* in italics (Farrell & Ventura, 1998; Oyoo, 2008). The questionnaire papers had clear instructions so that the learner participants would know what to do. In accordance with government policy; most schools in South Africa have lessons lasting between 35 and 40 minutes. Consequently, a double lesson of 70 to 80 minutes was ideal for administering the questionnaire with 25 items, mark and analyse the responses and then interview the participants in one encounter. This was first tested in the piloting phase as explained in section 3.8. The participants would respond to the questions in about 20 minutes, then the researcher would mark and sort out the scripts in about 10 to 15 minutes, and the rest of the time would be left for the interview discussions with the participant learners.

The participants answered the questionnaire items by selecting the best answer out of the four possible answers provide. As an example, a question item would be presented in the following format:

The beam balance is a very sensitive instrument. This means that it
A. can be used to measure very small things
B. can only be used by sensitive people
C. it is hard to understand how it works
D. gets spoilt very easily

A full questionnaire paper and an answer sheet are available in Appendix A.

3.3.3. *The Interview*

According to Fischler (2005), it is possible in an interview to get a deep insight of the respondent's system of beliefs and knowledge. One of the aims of an interview is to understand the participant's views. There are many different types of interviews, namely problem focused interview, group discussions, narrative interview, participatory interview and "one on one interview" (Creswell, 2012). In the group discussions, information concerning views, opinions and beliefs are shared by the group of people participating in that study (Fischler, 2005, p. 29). According to Confrey (1990), if one wants to know more about

knowledge of something, then one should ask the people who claim to or are thought to know about that particular thing.

In this study the interview method for data collection was used to augment the data collected by the use of the questionnaire method. After administering a questionnaire to the learners, it was necessary to know their views, opinions and beliefs concerning their choices. The teachers were also interviewed in order to determine whether their explanations during the teaching process influence the learners' understanding of the contextual meaning of the everyday words in science. Through interviews, the learners and teachers were able to verbally say what they were thinking about the words used in the questionnaire. Consequently, the interview was to provide possible answers to the second and third research questions:

- What are the learners' meanings and explanations to some everyday words when used in the Physics context?
- Do the teachers' explanations influence the learners' understanding of some everyday words as used in the Physics context?

In order to have possible answers to these two research questions, it was important to carefully plan for the interviews. Specific issues to be explored in the interview were prepared well in advance by having an interview guide or schedule ready. Interview guides or schedules help the interviewer to be focused during the interview on the issues at hand (Fischler, 2005).

3.3.4. *Interview design*

The interviews can be classified as structured or semi-structured (Oyoo, 2009). This depends on the types of questions the interviewer poses to the respondent. In a structured interview, the interviewer takes the lead with some guidelines, where the set of questions used is rigorous with no permission to divert (McMillan & Schumacher, 2010; Creswell, 2012). On the other hand, a semi-structured interview is open, permiting the interviewer to bring in new ideas during the interview depending on the interviewee's responses. Also, in a semi-structured interview, there is a framework of themes that have to be explored. In this study, the researcher followed the semi-structured interview for both learners and teachers in order to obtain more information. It enables participants to freely express themselves to some extent, but, at the same time be guided by what the researcher is focussing on in terms of the

aims and objectives of the study. The researcher used a learner interview schedule and a teacher interview schedule as a guideline for the interviews in this study.

The learner participants were to be asked about the link between the meanings of some selected words in connection with what they selected as the meaning of those words in the questionnaire items and what their teachers taught them. As explained earlier in the opening statement of this section, the interview was used to augment the learner participants' choices in their questionnaire answers, and, to give them room to explain the reasoning behind their choices. The teachers were, in turn, to be interviewed about their learners' responses in the questionnaire as well as the learner interview responses. This implies that the teacher participant's interview was about their learners responses (for the questionnaire and interview). Interviews were to help to provide clarifications about particular responses and also to give flexibility in reasons (or lack of reasons) in favour of a particular answer (Smith, 1990) in McMillan & Schumacher (2010, p. 355).

The semi-structured interview schedule questioning with *funnelling* was first introduced by Chiuer *et al.* (1999) where the questioning technique is initially more general and then becoming more specific. They generally probe the interviewee's knowledge of the background or contextual factors of the surrounding community. In this study, the researcher also employed this type of interview questions because they "minimize power differential between the interviewer and the interviewee" (McMillan & Schumacher, 2010, p. 355) by making the participant feel relaxed. The following excerpt is an example of *funnelling* in a teacher interview for school Q in this study:

> R: Alright, I would like you to give me a brief background of your school…..Eh……like what kind of school is this one, for example, is it a former Model C school or what……..
>
> T: I believe this is a former Model C School, eh, but normally most of our learners come from Soweto, even though we also enrol learners from the surrounding areas of Bez Valley, Kensington and some from Yeoville……it's actually a mixture……..they don't actually come from one fixed area…..

In the discussion, the interviewer (R) asks the participant teacher (T) about the school's background at the beginning of the interview. The respondent provides an answer that will later on become an important source of information about the context of the school and the participant learners involved in the study.

In all the five schools, the student interviews were conducted immediately after the Questionnaire was administered to the participant learners. Owing to time limitations, the learners were interviewed as one group instead of ideally dividing them into two or smaller groups. An example of the questions in the learner interview schedule included the following whilst the full semi structured interview schedule for learners is in Appendix B:

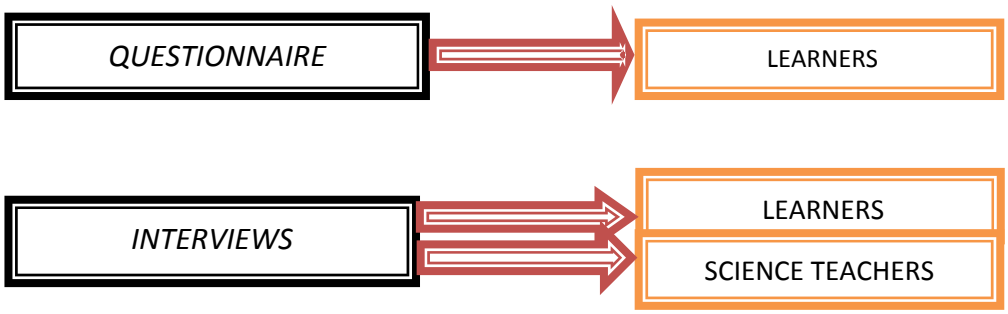
1. Is the word …… familiar to you? If so, when did you first encounter the word?
    - How often have you used the word? Where? How?
    - How often do your teachers in the science classrooms use this word?
    - You gave ……., as the meaning of this word. How did you arrive at this as the meaning of the word?

As mentioned earlier, the teacher's interview was to follow after the researcher had analysed the student participants' questionnaire and interview answers. An example of some of the questions included in the teacher participants' interview schedule is shown below: (The full text Schedule is in Appendix B)

1. What does the word …… mean to you? Many of your learners gave……. as the meaning of this word. Do you agree with their definition? Why?
2. Which topics or sections do you normally use this word in your science lessons?
    - Do you normally explain or provide the meaning of this word to your learners?

In order to summarise the approach followed to collect data, the strategy is shown in Figure 3.2. The questionnaire was the prime method of data collection using the learners whilst the interviews were complementary methods of data collection.

FIGURE 3.2: Summary of the data collection strategy



Now that the methods of data collection have been fully discussed, the next section analyses the piloting and then the sampling involved in this study.

3.3.5. *The Piloting process*

According to Bell (2005) and McMillan and Schumacher (2010) it is vital for any research study's data gathering instruments to be piloted. This process is meant to ensure that validity and reliability is safe-guarded. It is meant for proper planning and checking to establish whether questions and instruments are concise, clear and not ambiguous. Also, it is meant to check for the time the respondents take to answers questions before the actual data collection process begins. The process of piloting gives the study the direction.

In the case of this study, the piloting was carried out at the school where the researcher was employed as an educator, using his grade 11 physical science learners. There were 23 learners (n=23) who participated in the pilot sample. A summary of the number of participant learners and their gender is provided in Table 3.1.

TABLE 3.1: Number of learner participants in the pilot school

School	Total number of learners in class	Actual number of participating learners	Actual number of participating boys	Actual number of participating girls
Pilot	23	23	10	13

The table shows that the sample had more girls than boys. The school is a former model C type also situated in the city of Johannesburg with most of its learner population coming from the distant townships of Soweto, Alexandra and Thokoza.

This piloting test enabled the researcher to check the feasibility of the actual study in the target population. When the questionnaire was administered, the learners took about 20 minutes to complete. They were answering on the questionnaire papers provided by encircling their best choices. The marking and sorting out process of the answer scripts took long and this made participant learners to get restless since they were doing nothing, awaiting the researcher to complete the marking, analysis and sorting of answers. The researcher noted this and decided to use a separate answer paper for the actual study. The answer scripts would then be marked using a special grid paper in which the correct answers were cut out. This was then placed on top of the participant learner's answer sheet for a quick scan and count as a way of marking. The modified answer script and grid for answers (memorandum of answers) is provided in Appendix A-2 and 3. The 25 questionnaire items used during the piloting stage were not changed because the participant learners were able to answer them in 20 minutes.

The questionnaire used during the piloting stage is available in Appendix A-1. This was the same questionnaire used without modifications in the main study.

The learners' interview was conducted soon after the marking and sorting out of the questionnaire answer scripts as a mock exercise because it was not audio recorded. The interview process was carried out with the entire group of learners in the same classroom where they answered the questionnaire. The entire exercise of piloting was completed within 70 minutes, the time allocated for a double period at this school.

The researcher also made use of the experience gained whilst conducting a similar and smaller study, Bachelor of Science Honours level, earlier in 2011. That study involved only 2 schools and 28 high school learners and 2 educators only.

3.4. THE STUDY SAMPLE

There are many sampling methods that could be used to select the sample of participant schools. However, the researcher considers that the convenience sampling method would be more suitable for this study (Schumacher & McMillan 2010). The schools were selected on the basis of being accessible as well as having the learner population with the characteristics expected for this study (Creswell, 2012). These schools have a mixture of learners speaking different languages, with the majority of them being second language speakers of English, the language of instruction. Also, the majority of these learners commute from the outlying townships of the city of Johannesburg. The convenient location of the schools also offered the researcher some advantages in terms of time management and travelling costs.

The sample in this study involved learners (n=105) in grade 11 and 12 (Form 4 and 5 equivalent) in five schools in the city of Johannesburg. This sample actually consisted of 84 grade learners 11 and 21 grade 12 learners, giving a grand total of 105 learner participants. All the learners in the sample schools study Physical Science as part of their subject combination. There were 5 teachers of Physical Science for these learners who also formed part of the sample.

3.4.1. *Sampling*

The five schools conveniently selected are all are mixed gender schools. Four of these schools (School L, M, N and Q) are government schools called "former model C" types in the same locality, near the city centre, where the researcher works. During the apartheid era,

model C schools were very well resourced because they were meant for the minority white population only. In the post-apartheid era, they have emerged as better schools in terms of infra-structure, maintenance, management and resources since they are allowed to charge school fees. They also attract more experienced and better qualified teachers because they are conveniently located around the buzz and glamour of 'the city centre of gold', Johannesburg (Howe, 2003; Mji & Makgato, 2006). The fifth one (School D) is a new school with temporary building structures for classrooms. It is located near densely populated squatter camps and Denver Hostels of the poorest of the poor in Johannesburg, not far from the other four schools. This is a state funded no fee paying school meant for the economically disadvantaged members of the society, where learners even receive cooked meals during an hour long lunch break.

The majority of the learners attending at these four schools (Schools L, M, N and Q) commute from the townships by train, buses and taxis, 10 to 20 kilometres away because they are attracted to these better equipped schools (compared to the ones nearer to their homes in the townships. The townships are high density suburbs of the middle class and poorer citizens. The habit of shunning the *no-fee paying* township schools in favour of the expensive former model C schools is one of the typical features of several urban South African schools in the post 1994 era (Milazi, 2003). These schools also accommodate fewer learners from the surrounding suburbs that may be classified as "medium and low density" for the middle class residents of Johannesburg.

TABLE 3.2: Number of learner participants per school

School	Total number of learners in class list	Actual number of participating learners	Actual number of participating boys	Actual number of participating girls
D	33	27	12	15
L	10	10	2	8
M	34	31	14	17
N	18	16	10	6
Q	21	21	8	13

The total number of learners in the class list per school that was presented to the researcher did not correspond with the actual numbers that participated in the research as a result of

absenteeism in some schools. Table 3.2 shows the numbers of learners per school present during the day of data collection against the apparent total number of learners on the class list.

It was noted that the number of girls doing physical science as a subject outnumbered the number of boys in all schools in the sample, save for one. This trend was also observed in the pilot study. This trend is in contrast with the tradition that "the more masculine the branch of science (e.g., physics), the less likely it is that girls will like it or do well" (Brickhouse, Lowery & Schultz, 2000, p. 441). Other researchers have observed that the girl child is lagging behind in science education compared to the boy child (Greenfield, 1996; Baker, 1998; Oyoo, 2010). This was an interesting observation worth stating in this study.

In all the sample schools involved in the study, the language of instruction was English. The most dominant home language was Zulu for all grade 11 groups. In school Q with grade 12 participant learners, there was a sizable proportion (33%) of the learners that indicated English as their home language. Table 3.3 shows the summary of the home language distribution per grade per school.

TABLE 3.3: Distribution of learner home language per school

	Grad	n	Eng	Zul	Xho	Ped	Sot	Tsw	Swa	Tso	Ven	Oth
D	11	27	0	20	3	1	0	0	0	0	0	3
L	11	10	1	3	1	0	0	0	0	1	0	4
M	11	31	2	15	5	0	1	1	0	2	2	3
N	11	16	1	8	1	0	0	1	2	1	1	1
Q	12	21	7	5	0	0	0	2	2	0	1	4

Key: Grad-Grade; Eng-English; Zul-Zulu; Xho-Xhosa; Ped-Pedi (Northern Sotho); Tsw-Tswana; Sot-Sotho; Swa-Swati; Tso-Tsonga; Ven-Venda; Oth-Other languages like French, and Portuguese.

From the summary in the table, it shows that very few learner participants were first language speakers of English. Consequently, the majority of the learners were second language speakers of English, the language of instruction in all the schools D, L, M, N, and Q. Out of the total number of participant learners in each of the groups, the second language learners constituted 67% for school Q, 94% for school N, 94% for school M, 90% for school L and 100% for school D. This worked well since one of the objectives of this study as indicated in the introduction section was that the sample should, in the majority, consist of second language speakers of English, the language of instruction.

The selected educator participants were those that taught the participant learners at the time of conducting this study. Consequently, the participant teachers' background information was then solicited in order to be used later during the analysis of interviews. Table 3.4 shows a summary of the participant teacher details per school. All the teachers were university graduates and they had 4 years (or above) of teaching experience.

TABLE 3.4: Summary of personal details of the educator participants

Sch	Number of years of teaching experience	Qualification	Gender	Citizenship or country of birth	Subject specialisation at university/college	Actual subjects taught
D	16	Bachelor of Education (Science)	Male	South African	Physical science; Mathematics	Physical science
L	6	Bachelor of Education (Science)	Male	Nigerian	Physical science; Mathematics	Mathematics; Physical Science
M	6	Bachelor of Science (Honours)	Male	Zimbabwean	Mathematics; Physics	Physical Science
N	4	Bachelor of Education (Science)	Male	South African	Physical science; Life science	Physical Science; Natural sciences
Q	18	Bachelor of Science; Bachelor of Science (Honours)	Male	Zimbabwean	Chemistry; Biology; Physical science	Physical Science; Natural sciences

Key: Sch- School

They all teach a subject that they specialised for during their teacher training at university. It was noted earlier in the introduction chapter (section 1.2.2. *Poor performance in the physical sciences subject examinations*') that South Africa depends on expatriate labour to meet its needs in science related fields. The Table 3.4 confirms this problem, 20 years after the first democratic elections because 3 out of the 5 physical science teachers in the study sample are foreigners. Another observation is that all the Physical science teachers in this study are males. This is probably another legacy of the gender imbalances in choosing science subjects in secondary schools and universities with respect to the older generations (Brickhouse *et al*., 2000).

3.5. ETHICAL ISSUES AND ACTUAL DATA COLLECTION

3.5.1. *Planning and ethics*

In data collection, if there is a higher return percentage of the questionnaires, the better the data (Gay *et al*., 2006). Also, Robson (2007) reiterates that many surveys usually suffer from poor response. Consequently, in this study, the questionnaires were self-administered to the participants in order obtain a 100 per cent response rate as recommended by Gay *et al*. (2006). Initially, permission had to be requested from the Department of Education to use state funded schools in the study. Also, an application (Appendix F-9) to the Ethics committee of the University of the Witwatersrand was forwarded for the research proposal and ethics procedures to be approved.

The Department of Education granted permission for the researcher to visit the schools for a maximum of two days and the approval letter is available in Appendix F-8. Consequently, the researcher used the first day in each of the 5 schools to introduce himself to the school principal, explain the purpose of the study, and to negotiate with the physical science educators for possible dates of data collection and to obtain class lists of participant learners.

As mentioned earlier, the data collection process involved the use of a questionnaire for the high school science learners whilst the interviews were for both the learner participants and their teachers. The data collection strategy is summarised in Figure 3.2.

The actual process of data collection started during the week of August towards the end of third term according to the South African schools calendar. It is important for every study to comply with all ethical aspects for validity and reliability as stressed by the University's ethical code of conduct (Vithal & Jansen, 1997). Validity refers to the "extent to which data and subsequent findings present accurate pictures of the events they claim to be describing" (Hitchcock & Hughes, 1989, p. 89). It is an attempt to check out whether the interpretation and meaning of a particular event is sound or whether a particular measure is an accurate reflection of what the researcher aims to find out. Consequently, in this research report, the researcher concerned himself before and during the study with the right procedures in order for the study to meet characteristics of being good and valid as described by Bell (2005). The letters of request were personally hand delivered by the researcher to the respective heads of schools.

The researcher identified himself in all communications letters and forms, respecting the participants' privacy, and upholding their anonymity as well confidentiality wherever expected. The wording of the consent/requests letters to all concerned support this and it is available in Appendix F. The questionnaire items used was adopted from the ones used many times before by accredited researchers. The researcher ensured that all ethical issues like confidentiality of the participants' responses as well as anonymity were respected by reminding the participants to identify themselves with codes allocated to them at the start of the exercise, for example, all participants in school D were identified by a number with a prefix D, say D1, D2 and D3. There were spaces provided for the respondent's to indicate their gender, language spoken at home and language spoken at school for the purpose of statistical analysis. The participants were also told that they would be audio taped as a way of capturing all their interview responses.

The respondents were to be provided with specially structured answer sheets, where they merely encircled the letter representing their choices. This strategy, employed after correcting the problems of time wasting during the pilot study, saved time for the respondents and researcher (when marking). It must be reiterated that time management was very important in this exercise. The researcher was to ensure that all ethical issues like confidentiality of the participants' responses as well as anonymity were respected by reminding the participants to identify themselves with codes allocated to them at the start of the exercise. There was space provided for the respondents to indicate their gender, language spoken at home and language spoken at school for the purpose of statistical analysis.

In all the five schools, the student interviews were conducted immediately after the Questionnaire was administered to the participant learners. Owing to time limitations, the learners were interviewed as one group instead of ideally dividing them into two or more smaller groups. Following Clerk and Rutherford's (2000) method of approach, in this study, the participant learners were asked to verbally explain the reasoning behind some of the answers in their questionnaire responses. Consequently, the questions used during the interview were dependent on the semi structured interview schedule questions. The other questions propped up as 'ad hoc' and unplanned (Clerk & Rutherford, 2000, p. 708) because these were prompted by the direction of responses of the participants relative to the planned questions. A good example is the following excerpt (Appendix C-3: Learner interview for

school M) where the initial question was a planned one but the second one was prompted by the participant's response to the initial question:

R: Do you know the meaning of the word characteristic, guys?

All: Yes!

R: Alright, you think you know that? Let's be free…let's start debating….what's the meaning of characteristic?

L4: I do not know the meaning now……

R: Alright, give us an example…….(silence)…..So you do not know the meaning of characteristic? Ehhh?

L4: I think it means something unique, I have my own character and she has her own…

R: okay, unique…..what about you?

L5: It means differentiation…

I: What do you mean by differentiation?

L5: ….Like…..let's compare BLACKBERRY and NOKIA

R: Oh, you mean phones? So how does characteristic come in there?

L3: The quality of their pictures….

R: So those are their characteristics…?

L3: Yes….

R: So when you are using that word characteristic, you are trying to….differentiate?

All: Yah!

In order to capture as much information as possible, the researcher also wrote field notes alongside the audio recording of the participants' interviews.

3.5.2. *Actual Data Collection*

Data collection in School D

The school is situated about 4 kilometres away from where the researcher was employed. The researcher asked for permission to conduct a study at the school directly at the principal's office, by presenting the request letter and the GDE letter of approval. Permission was immediately granted but the researcher was allowed to work with the grade 11 learners, not grade 12 learners. The reason why the researcher was denied the grade 12 learners was the tight schedule these learners had in their time table. The school had one class of physical science per grade. With permission granted, the next step was to arrange for convenient dates with the teacher concerned. The 24th of September was then set to be a convenient day by the teacher and the researcher for data collection in this school. This took place a week later after

the letters of consent for the participant learners and parents of learners below the age of 18 years were dispatched.

Out of 33 learners in class, 27 were present on the day of data collection. The response was positive concerning the consent forms which were collected by the teacher on behalf of the researcher from the learners under the age of 18 years. Also, the learners present were well behaved and cooperative. The questionnaire was then answered within 15 to 25 minutes. As the participants gradually handed in their completed answer scripts over a 10 minute period, the researcher was able to easily mark and sort them out in preparation for the interview. The marked scripts were sorted by selecting response items that presented the largest number of incorrect choices and these guided the interview questioning. The summary of all the scores of participating learners is available in Appendix E (School D).

There were some disruption when the learner interviews were about to start. This was owed to the principal of the school who came to the class to fetch 5 learners for disciplinary issues. Despite this minor interruption, a whole class interview was conducted in order to save time in the classroom where they normally receive their lessons. In this school, learners stay and use one class room for all their lessons whilst the teachers move from class to class to impart lessons. Another observation was that the school did not have a specialist laboratory for science. During the interview, many learners were initially reserved. The researcher noted that this was because such learners had difficulties in verbally expressing themselves in English. The researcher then encouraged them to explain in their home languages. The following excerpt shows how the interviewer (R) was tried to encourage the participant learners (L) to take part in the conversation using their home language:

> R: Okay…...Do you know the meaning of this word? What does adjacent mean to you? Whether you are wrong or right, you have some meaning of this word of some sort. What does this word mean to you? Eh...Who is the ice breaker (Interviewer trying to coerce the learners to respond)…….you can *khuluma ngesiZulu* (speak in Zulu), no problem….(prolonged silence)……..Yes. …..It means what?

After some time, more learners began to participate with zeal, freely expressing themselves in isiZulu. The word *sound* as the correct answer to item number 6 (Appendix A) generated a lot of debate and interest. The excerpt below shows how one of the learners was trying to explain to the class the contextual meaning of the word *sound* in isiZulu:

L3: Not that *sound*, ngisho ukuthi uyayi 'andastenda', hayi ukuthi uyayizwa... (I mean that you understand, not that you hear it).

R: Uyizwakanjani? Enqondweni zakho iyakhuluma? (How do you understand it? Does it talk in your head? (Learners laughing)

L3: Ngithi lento iya 'andastendeka'…hayi ukuthi uyayizwa (I'm saying that this is understandable not that you are hearing it….

The researcher got more than the planned for the interview when the teacher who was meant to take over announced that she was not feeling well to teach. However, it emerged later that the teacher was taking advantage of the situation in order to avoid teaching the class! The full interview was later transcribed and the full version is available in Appendix C-1.

After the learner interviews, the teacher interview was to follow by arrangement. The researcher had to return to this school after school hours for the teacher interview. The interview was conducted smoothly; however, the teacher had a tendency of not answering the questions asked by diverting the discussion to other issues. The excerpt that follows illustrates how this educator (T) deliberately diverted from important issues asked by the researcher (R):

R: Are you aware that some of these words can take some contextual meaning, like this word *sensitive*, it can have a meaning which is particular in Physical Science but when it is used outside the science classroom, it changes to something else…are you aware of that?

T: Yah,…..that is true……

T: If I may ask, what are you finding in terms of teaching using African languages in schools…..?

R: I am afraid, that is not in line with what I am researching for now or in my previous research. This one is about the use of everyday words and how they change their meaning depending on contexts…

Also, the time that the teacher allocated the researcher was very limited such that very few planned aspects of the interview schedule were covered. The full text of the interview transcript of the teacher interview for school D is available in Appendix D-1.

Data Collection in School L

The request letter to the principal was hand delivered to this school together with the GDE approval letter to the principal's office. The principal, who was very cooperative, immediately allowed the researcher to meet with the only physical science teacher of the school to arrange possible dates and to issue out the learner consent forms. However, the researcher was instructed to use the grade 11 class only for similar reasons mentioned earlier

in this section concerning GDE rules. The 26th of September was the date allocated for the researcher to return for the data collection process. On this day, the principal again welcomed the researcher and immediately sent for the physical science teacher. The teacher then accompanied researcher to his classroom where he explained to the learners the purpose of the visit. The learners, mostly girls, were all present and appeared very enthusiastic when it was further explained to them that the exercise would last for the entire double lesson. It was obvious that part of excitement was generated by the fact that they needed a change of activity, something different from the routine lessons of physical science. The majority of the learners orderly completed the questionnaire in 15 to 20 minutes. The summary of all the scores of participating learners is available in Appendix E (School L).

The marking and sorting out of answers was completed in a short space of time because the class was very small. The learner interview was done with all the 10 participants at once (because it was such a small group after all) in the classroom. The group was very responsive, contributing intelligent answers, clearly showing that most of them had a higher level of English language proficiency. The full interview was later transcribed and the full version is available in Appendix C-5.

When the learners' interview was over, the teacher's interview followed during break time of that school. The teacher interview went on smoothly without problems in the storeroom of the school's laboratory. This location was chosen because it was quite, away from disruptions. The teacher was thus able to freely express himself in accordance with the ethical norms of research studies. Besides the data related to the way the learners responded to the questionnaire items, the teacher also provided valuable information on the background of the school and the learners. As mentioned earlier in the literature review chapter in section 2.2, such back ground set ups influence the learners' way of thinking and understanding.

Data Collection in School M

The principal's request letter to school M was hand delivered by the researcher. The permission was not immediately granted because the principal was out of office. The researcher had to return to the school the following day for the response and preliminary discussions with the principal. The permission to conduct the study at this school was granted with conditions that the researcher use only the grade 11 classes after agreeing with the head of department and the physical science teachers concerned. In this school, there were two grade 11 streams doing physical science. There was a lengthy discussion where only one

accepted and set the date for data collection to be the 15th of October. The letters of consent for learners were immediately handed out to the learners after the discussion. On the day of data collection, the Head of the Science Department of the school welcomed the researcher, and ushered him to the Physical science classroom concerned. There were 3 learners absent in that class for that day. The questionnaire was completed in about 20 minutes whilst the marking and the sorting out of the answer scripts took longer compared to school L. This was attributed to the size of the class. The summary of all the scores of participating learners is available in Appendix E (School M). One notable observation was that the class performed very poorly in the items with the words *disintegrate* and *convention*.

The learners were not divided into smaller groups during the interview session owing to time constraints. The participant learners in this group were quite vocal during the interview, participating freely. The full interview was then transcribed and the full version is available in Appendix C-3.

The teacher's interview was conducted two days later during the school's break time in an empty classroom. The teacher was barely audible during the interview and he appeared very unsettled for unknown reasons. After noting this, researcher tested the teacher by asking him to give possible answers to some questionnaire items done by his learners.

Data Collection in School N

The researcher hand delivered the principal's request letter and the GDE letter of approval in person to the principal's office during the school's lunch break hour. After reading the letters, the principal verbally granted permission for the researcher to conduct the study in her school. She then referred the researcher to the Head of Department for science who in turn invited the two physical science teachers to discuss and make arrangements for the exercise. The grade 11 teacher accepted to be involved in the study with his grade 11 learners whilst the grade 12 teacher declined. A date for data collection was also proposed whilst the teacher agreed to issue the letters of consent to his learners.

On the 18th of October, the researcher went to school N to collect data. This was the date selected by the physical science teacher. On that day, some of the learners asked for permission to go to the toilet before the exercise started and they did not return. Their teacher had warned the researcher to lock up the door during the exercise! However, the researcher did not do so because participation was voluntary as stipulated in the ethics code of conduct.

The teacher later apologised and mentioned that there was a serious problem of discipline at the school, particularly of "bunking" lessons and deliberate absenteeism. Nevertheless, the present participants responded to the questionnaire within an average period of 25 minutes. The participant learners were reminded to immediately hand in their completed answer scripts for marking. In about 15 minutes, the marking and sorting out of answers in terms of performance was completed. Whilst the researcher was marking and sorting out the questionnaire answers, the participant learners were very rowdy, unsettled and ill-behaved. They said that they were not pleased with doing an exercise that was "not meant for marks" each time the researcher asked them to be settled. The summary of all the scores of participating learners is available in Appendix E (School N).

The learners' interview was also done with the entire group save for 5 other participants who had gone to the toilet. The group was responsive but the participants occasionally argued amongst themselves such that the researcher had to continuously remind them that the exercise was voluntary and that they were not obliged to participate. However, none of the remaining participants asked for permission to leave. The following excerpt shows the level of ill-discipline in this group when they were discussing the meaning of the word "random" (item 12 of the questionnaire):

> L11: Noma yini, sir (What-ever, sir). ……(Other learners laughing)
>
> R: What about you?
>
> L12: …it means no order
>
> L13:….Jwayelekile, noma kanjani (usual…anyhow)
>
> L12: No order at all…
>
> R: ……okay, what do you mean by no order at all, okay in everyday life?
>
> L12: If a taxi moves anyhow and collides with other cars, it means it happens randomly…
>
> L6: Sir, like you…..you walked in randomly whilst we were learning.
>
> R:……Okay……(Laughing)….I see …I walked in randomly and then I affected your learning, is it so?.
>
> All: Yes!!!

In this excerpt, participant L6 was apparently trying to express some displeasure at the researcher for conducting a study during their lesson. The researcher again reminded them that the exercise was voluntary and that they had agreed to participate. In many instances, the researcher got negative answers, particularly when the learners were asked whether their

teacher explained certain words during the lessons. The answer was always a thunderous "No..!!!". To the researcher, this appeared as if they wanted to get back at their teacher for some unknown issues. The researcher considers this as an issue of ill behaviour and this is supported by other studies related to the behaviour of learners coming from previously disadvantaged areas of South Africa (Legotlo, Maaga & Sebego, 2002; Motseke, 2013).

According to Legotlo *et al.* (p. 116, 2002), such learners lack commitment and perseverance in their studies; they also lack discipline which eventually leads to uncontrollable behaviour. Learners deliberately ignore teachers' instructions and challenge authority but this eventually affects their performance in examinations. When the learners "are asked to do something in class, they protest and refuse to carry out instructions …..(because)…they abuse so-called *rights*".

The full interview was later transcribed and the full version is available in Appendix C-4.

The teacher's interview was conducted after school hours on the same day and it went on smoothly with no problems. The teacher invited the researcher to sit in his car during the interview citing that he felt more comfortable in it. The teacher gave valuable information about the school's background and gave a word of caution to the researcher about this group of learners' wayward behaviour as illustrated in the following excerpt:

> T: …(Laughing) You have to be very careful with that class.
>
> R: How is the class?
>
> T: You need to be very careful with that class. Sometimes it will say some things just to test or to pull you out of what you are trying to say to them…..if you look at that word *characteristic*, and then you can say: what are the characteristics of metals?, just like that…
>
> R: So they have met the word before?
>
> T: They have met the word before in grade 10 because it is the very same class I taught in grade 10 and I taught them again in grade 11…so they have met almost a lot of these words if you look at these learners, there are two or three learners that will answer everything honestly to you, the rest will create jokes
>
> R: Is it their back ground, where they come from, that make them behave that way?
>
> T: If they do not understand something, they tend to make jokes and if they understand, you see them being serious and they will be quite… so you need to get them to a point where they understand concepts…but the moment they lose you, their concentration goes and jokes come up….

Data Collection in School Q

The researcher also hand delivered the principal's request letter and the GDE approval letter to the school. The principal advised the researcher to phone his office the following day in order to give him to consult with the Head of Department for science. The request was accepted telephonically and the researcher was invited to discuss the arrangements with the physical science teacher during the school's lunch hour break. On that day, the physical science teacher actually allowed the researcher to use grade 12 learners and selected the 24th of October as the day for data collection.

On the day of data collection, the principal of the school personally accompanied the researcher to the physical science laboratory, where we found the teacher and the learners already waiting. All the 21 learner participants in this school were present. The researcher was welcomed by learners who stood up to greet him. This was a very modest gesture compared to what the researcher went through at school N. The teacher went on to explain the purpose of the exercise and the learners appeared willing to participate in the study. Most of the learners completed the questionnaire in less than 20 minutes and they waited quietly as the researcher marked, analysed and sorted the answer scripts. The level of respect and orderly behaviour of the learners at this school really impressed the researcher. Later, after inquiring about this observation, the physical science teacher pointed at the surveillance cameras inside the classroom. He said that all classrooms, corridors, toilets and 'dark corners' had cameras! Any learner who misbehaved would be immediately spotted and then punished by the principal.

In about 10 minutes, the marking and sorting out of answers in terms of performance was completed. Compared to all the other schools, their performance was better in all the 5 items in the questionnaire considered to be the most difficult. The summary of all the scores of participating learners is available in Appendix E (School Q). The learners' interview was conducted in the laboratory where they learn science. This exercise was carried out orderly and the participant learners were exceedingly cooperative.

The teacher's interview was conducted a week later due to time constraints. This happened late after school hours in an empty laboratory. The interview went on smoothly with no problems and the teacher provided very valuable information about his school. The following excerpt is an example of *funnelling* in a teacher interview for school Q in this study:

R: Alright, I would like you to give me a brief background of your school…..Eh……like what kind of school is this one, for example, is it a former Model C school or what……..

T: I believe this is a former Model C School, eh, but normally most of our learners come from Soweto, even though we also enrol learners from the surrounding areas of Bez Valley, Kensington and some from Yeoville - it's actually a mixture……..they don't actually come from one fixed area…..

In the discussion, the interviewer (R) asks the participant teacher (T) about the school's background at the beginning of the interview. The respondent provides an answer that will later on become an important source of information about the context of the school and the participant learners involved in the study.

3.5.3 *Data collection reflections and observations*

During the learners' interviews, the groups were not sub-divided into smaller sub groups in all schools as initially planned. This move proved very problematic in some schools because of ill-discipline (School N). Other schools had large numbers of learners who were difficult to control.

3.6. DATA ANALYSIS STRATEGY

Gay *et al*. (2006, p. 5) describes data analysis as a systematic organization and synthesis of data that involves application of one or more analysis methods. This therefore gives meaning to the collected data during study and this permits the researcher to answer the research questions. The data gathered in this study was analysed on the basis of the responses that were given by respondents. There were a total of 105 of learners' questionnaires that were completed and 10 interviews of both learners and educators collected as data. The researcher then examined the response patterns of the questionnaire items in relation to the interview responses given by respondents.

McMillan and Schumacher (2010), refer to descriptive statistics as summary statistics, where results or data are used to summarise, reduce and organise large numbers of observations. The study employed a *descriptive* analysis of the data (Opie, 2010). This is owed to the fact that the sample was small and that the research is mainly qualitative and to a lesser extent, partly quantitative.

The Data from the questionnaires was organized according to the number of scores (correct or wrong) per questionnaire item per school. The items with high cases of incorrect choices

were then considered during the participant learners' interviews. The aim was to investigate the participants' difficulties with everyday words when used in a Physics context. Using tables and charts with all the scores per level per item, the researcher benchmarked the scores (incorrect relative to correct items). After selecting the apparently difficult words, using a simple criterion, they were then analyzed per school, corroborated with the data collected using the interview method from both learner and teacher participants.

Actually, the audio recorded interviews of all the participants were first transcribed and then coded with the aid of field notes. The researcher merely used the interviews to shed light on what influenced the learners in choosing particular answers as correct and stand by those answers when in reality they were incorrect.

3.7. CHAPTER SUMMARY

In this chapter, the researcher explored in detail the research design of the study, the research instruments, the sample and the data collection process. The next chapter will deal with the presentation, analysis and interpretation of the results obtained.

CHAPTER 4

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1. PREAMBLE

The study sought to address the following research questions:

(i) Do South African grade 11 and 12 physical science learners also encounter difficulties with everyday words when used in the Physics context?
(ii) What are the learners' meanings and explanations to some everyday words in Physics context?
(iii) Do the teachers' explanations influence the learners' understanding of some everyday words as used in the Physics context?

In addressing these questions, the participant learners were first given a questionnaire to answer as the main data gathering tool. This was followed by learner interviews and educator interviews. Consequently, the analysis of the interviews was in the form of narrations which occasionally included excerpts of what the participants said in comparison to those of other studies reviewed.

In this Chapter, the analyses of the data obtained during the study as well as the research findings are presented. The analysis of the learners' responses to the questionnaires, the learners' interview and the teachers' interview reports are presented, and order of these words discussed against the background of the literature reviewed earlier in this study and the research questions.

4.2. METHOD OF ANALYSIS

According to Schumacher and McMillan (2010, Pp. 486), "it is almost impossible to interpret data unless one organizes it". Consequently in this study, the data obtained using questionnaires was first organized according to the number of scores (correct or wrong) per questionnaire item per school. The items with highest cases of incorrect choices were then identified and then a simple criterion was used to select the most difficult words. From the Tables 4.2 and 4.3 and Appendix E, an item with about 60% or more *incorrect scores* (15/25) in most schools for the grade 11 participants was used as the bench mark for the most difficult words in the questionnaire. This is because in South Africa policy dictates that 40% is the minimum percentage pass mark for promotional purposes in school (DBE, 2009).

After selecting the most difficult words using the criterion explained, interviews were arranged with the participant learners and their teachers. In the learner interviews the selected most difficult words were used to establish the alternative meanings they harbored together with explanations to their effect. The teacher interviews were meant to establish trends, similarities and differences concerning their awareness to the existence of linguistic difficulties of learners when they use everyday words in the physics context. According to Kreuger (1988), interview analysis starts by comparing words, their emphasis and their intensity during the discussions. Consequently, the interview analysis in this study was done by identifying resurfacing trends in each focus group during the interviews (Ferreira, 2011).

Since the underlying objective of the learners' interviews was meant to establish their reasoning behind their responses to the questionnaire, then a qualitative comparison between their questionnaire responses and the interview data was done concerning these difficult words. In this way, it was possible to ascertain whether participants' had alternative contextual meanings to everyday words that made them to wrongly interpret physics concepts (Clerk & Rutherford, 2000).

The learner and teacher interviews were first transcribed in order to facilitate the process of analysis. The responses were assigned simple categories and codes. For learners, the categories were created to sum up the possible sources of the meanings of each of the most difficult words the participants selected when they were responding to the questionnaire. In the case of teachers, the created categories were also used to sum up the trends of their views and awareness of their learners' linguistic challenges.

The learners' actual answers from the questionnaire were given codes depending on their school, say **DA1**, **DA2**, **DA3**, etc. for school **D** and **LA1**, **LA2**, **LA3**, etc. for school L. The second letter **A** represented the participant learners' responses in a particular school, which is the first letter, say **D, L, M, N**or **Q** and these were numbered from 1 to the total number of respondents in that school. As an example, **DA2** represents a response that participant learner number 2 in school **D** gave during the questionnaire test. For the interviews, the codes used in the transcripts were **R** representing the researcher (Interviewer), **L** representing the participant learner and **T** representing the teacher. As an example for learner participants, the response that was given by the first participant learner is coded as **L1**, for the second learner it is **L2** and so on.

4.3. THE LANGUAGE FACTOR

There was some information to be obtained in relation to the learners' home language and summarised in table 3.3 in the sampling section of chapter 3. Many researchers consider that it is important to know about the learners' home language as part of his/her background (Milazi, 2003; Howe, 2003; Probyn, 2005). This information can be used to establish the relationship between proficiency in the language of instruction and the understanding of the contextual meanings of words. This information was compiled from learner details in each answer scripts illustrated in Appendix B**,** where the respondents were expected to indicate the language they use at home, the language they use at school, their grades and their gender before they proceeded to answer the questionnaire items.

The personal details supplied by the respondents were used to compute the relative performance of first and second language speakers of the language of instruction in answering the questionnaires for each school. The Table 4.1 summarises the mean scores of the first language speakers compared to the scores of the second language speakers.

TABLE 4.1 Relative performances of English 1st language learners per school

School	Grade	Number of English 1st language speakers	Group mean (%)	1st language speakers' mean (%)
D	11	0	51	-
L	11	1	71	72
M	11	2	57	68
N	11	1	63	72
Q	12	7	82	86

The English first language participants in school Q scored an average of 86% against the group average of 82%. In school N, the only first language English speaker scored 18/25 (72%) in relation to the group average of 63%. In school M, the two such participants scored 64% and 72% respectively against a group average of 57%. In school L, the only first English language speaker scored 72% where the group average was 71%. The percentage mean score for the first language speakers of English in each of the participant schools was higher than the groups' percentage mean scores. This implies that the English first language participants'

performance was above average in all the schools, save for school D which had no first language speaker of English. However, none of these first language speakers scored 100% when they answered the questionnaire items. This shows that the contextual meaning of everyday words is a problem to all learners despite their level of proficiency in the language of instruction (Ferreira, 2011). However, it should be noted that the second language speakers seem to be in a worse position than the first language speakers. Many researchers in other parts of the world have also obtained similar results which confirm, separately, that the first language speakers and the second language speakers of English have difficulties with the use of words in the science classroom language (Gardner, 1971 for Papua New Guinea; Tao, 1994 for Hong Kong; Farrell & Ventura, 1998 for Malta; Ismail & Ali, 2006 for Malaysia). Fewer researchers (Oyoo, 2000 for Kenya; Johnstone & Selepeng, 2000 for Botswana and UK) obtained results involving samples with both first and second language speakers of English in one study.

In school D, where there were no first language English speakers, the group's average was the lowest (51%) compared to other schools. During the interviews, many learners preferred to communicate in their home languages than in English language. This was probably owed to the learners' low proficiency in the language of instruction, which compromised their ability to freely express their views. Their poor command in the language of instruction is a learning barrier that becomes another problem added to the one affecting all learners - the difficulty in understanding the contextual meaning of everyday words (Farrell & Ventura, 1998; Ferreira, 2011).

4.4. THE QUESTIONNAIRE METHOD

In this section, the existence of difficulties encountered by the learners in the use of everyday words in the Physics context are presented with tables of comparison, percentages, and charts using data obtained after administering the questionnaire.

The summarised scores of each of the participants in the schools D, L, M and Q are presented in Appendix E. For each of these tables, the top numbers with letters (columns) represent the learner codes, which replaced the names of the participants (as stated in the confidentiality and anonymity clause of Ethical Code of conduct), and the extreme left hand numbers (rows) represent the items or question numbers (1 to 25) in the questionnaire. A tick (√) in the box signifies that the participant chose the correct answer for an item. The letter in the box shows the actual incorrect answer selected by the respondent. These tables give a summarised

picture of all the answers (wrong or right), the most popular choices and performance per school per item at one glance. There were some items that were not attempted by some participants. Such items appear as a blank in the tables and they were counted together with the wrong answers.

The researcher was able to identify a pattern in the word selection per school using the tables in Appendix E. It was interesting to establish that participants had a tendency of selecting the same wrong answer as if they had the same reasoning. A good example was the contextual meaning of the word *sensitive* (item 5) which appeared to be misunderstood by most learners (73 out of 105) participants who selected the incorrect meaning of this word as "getting spoilt easily". Another example in the same line of observation was the word *valid* (item 6) where 52 out of 105 in all participant schools consistently selected the incorrect contextual meaning of the word as "*brief*".

In order to clearly show the summary of the incorrect scores per participant school and the corresponding incorrect percentage attainment, the Table 4.2 was constructed, guided by the criteria explained earlier in section 4.2. The table shows the summary of the 25 words used in the questionnaire items, the incorrect scores per school, the total incorrect scores for that item for the 5 schools combined (N) and the corresponding combined percentage in the last column (extreme left hand side).

As an example, 24 learners out of 27 who participated in school D got the item 5, the word 'sensitive' incorrect and this translated to 89%. The subsequent wrong scores of the other 4 schools for this item are presented in the same row and then added up to give a total score of 87, translating to 83%. For each participant school, all the items whose percentage incorrect score was 60% and above, the score was tagged with an asterisk (*) as a difficult word for that school. Similarly, if the total incorrect scores of all the 5 schools for a particular item translated to *approximately* 60% and above, it was double asterisked to mark a difficult word for all the schools. This enabled the researcher to identify the most difficult words for each school and, for all schools combined so that it could be used to streamline and guide the learners' interview session. The information in Table 4.2 was also used to help the researcher to calculate the percentage achievements (correct) per item per school as illustrated in another table in Appendix I. In this table (appendix I), a high percentage value means that the word was well understood whilst a low value signifies difficulties with the interpretation or use of the word in that context.

TABLE 4.2: Distribution of incorrect scores per item per school

Question	Word	No. of inco. scores school D (n=27)	No. of inco. scores school L (n=10)	No. of inco. scores school M(n=31)	No. of inco. scores school N (n=16)	No. of inco. scores school Q (n=21)	n (Total inco.)	% Inco.
1	Consecutive	5	2	7	6	1	21	20
2	Device	13	3	10	9	4	39	37
3	Efficient	8	2	18*	6	2	36	34
4	Characteristic	14	1	15	7	4	41	39
5	Sensitive	24*	9*	26*	13*	15*	87**	83**
6	Valid	23*	8*	29*	12*	11	83**	79**
7	Linear	8	0	4	1	0	13	12
8	Consistent	17*	3	9	7	1	37	35
9	Evacuate	17*	0	11	2	1	31	30
10	Estimate	9	1	6	3	3	22	21
11	Conserve	3	0	1	1	1	6	6
12	Random	8	2	16	5	2	33	31
13	Limit	14	3	13	6	1	37	35
14	Fundamental	13	2	15	5	7	42	40
15	Contract	19*	7*	22*	16*	8	72**	69**
16	Generate	7	1	5	2	0	15	14
17	Displace	9	4	12	4	5	34	32
18	Function	5	1	4	1	1	12	11
19	Negligible	18*	3	19*	5	2	47	45
20	Convention	16*	8*	20*	9	8	61**	58**
21	Concept	17*	2	13	5	4	41	39
22	Classify	9	0	6	2	0	17	16
23	Disintegrate	17*	6*	17	10*	11	61**	58**
24	Source	16*	1	9	2	0	28	27
25	Adjacent	22*	4	24*	8	3	61**	58**

Key: Inco. -Incorrect; No. –Number; %- Percentage

Using the criterion explained earlier and basing on an attainment of nearly 60% and above of the participants getting it wrong, SIX words eventually identified as the most problematic for the majority of the learners in all the schools combined and this was. This implies that 61 or

more learners out of the 105 participants got the following words wrong. These words were: *sensitive, valid, contracts, convention, disintegrate,* and *adjacent.*

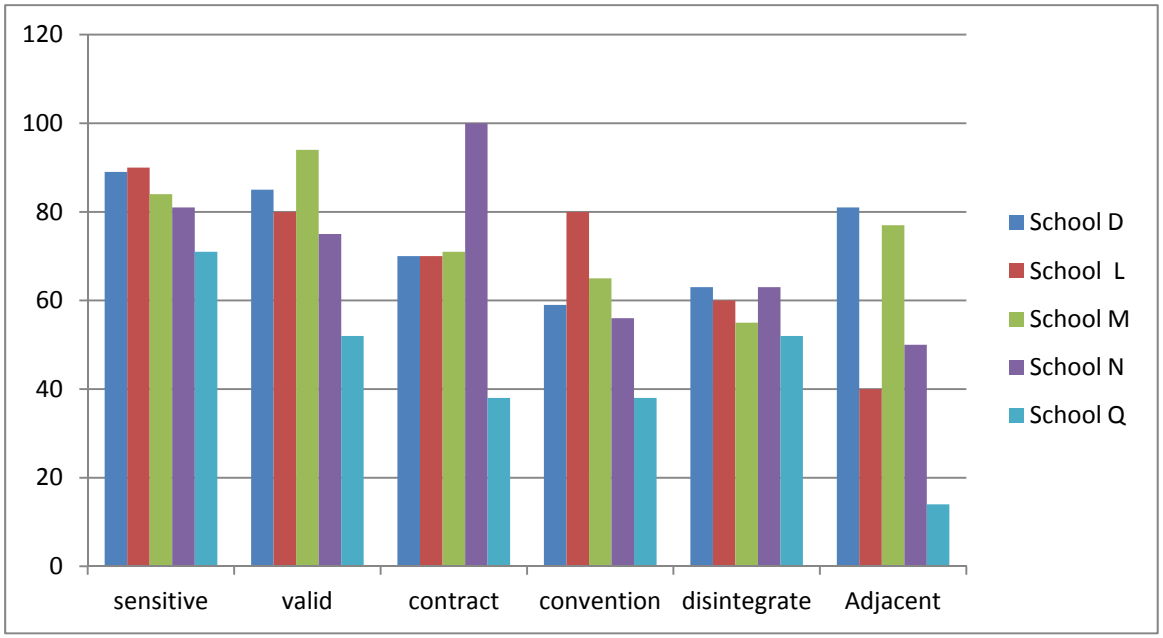
The researcher then used the data presented in Table 4.2 to express the scores as a percentage in each of the 5 participant schools the six most difficult words in Table 4.3**.** This data was also used to construct the chart shown in Figure 4.1. The chart is pictorial way of displaying the same data in the summarised table 4.2. The worst performing school for the 6 most difficult words was school D with a mean value of 75%, closely followed by school M with a mean value of 74%. The least affect school was school Q, with grade 12 learner participants, having a mean value of 44%. The chart and table 4.2 show that the worst performed items within the participant schools were for the word *contract* in school N where no learner got it correct and the word *sensitive*, in school L where 9 out of 10 of the learners got it incorrect.

TABLE 4.3: Summary of the most difficult words in the questionnaire expressed as a percentage

School	**Most difficult word (%)**						
	Sensitive	*Valid*	*Contract*	*Convection*	*Disintegrate*	*Adjacent*	**Mean %**
D	**89**	**85**	**70**	**59**	**63**	**81**	**75**
L	**90**	**80**	**70**	**80**	**60**	**40**	**70**
M	**84**	**94**	**71**	**65**	**55**	**77**	**74**
N	**81**	**75**	**100**	**56**	**63**	**50**	**71**
Q	**71**	**52**	**38**	**38**	**52**	**14**	**44**

The chart in Appendix H shows a similar summary for all the 25 items per school but for correct scores expressed as a percentage. It shows the percentage performance in the vertical axis against the 25 words in the horizontal axis. Such an arrangement shows at a glance the better performing schools and the weaker schools. The schools L and Q have four items where all the participants got them correct (100%). The lowest percentage correct scores were for the word *contract* for school N with a 0% achievement. The school M had 29 out of 31 participants getting the contextual meaning of the word *valid* incorrect and this translate to a 6% achievement.

FIGURE 4.1: The most difficult words in the questionnaire



In the literature reviewed, some of the words used in this study are also found to be difficult to learners in different parts of the world (Cassels & Johnstone, 1980; Muralidhar, 1991; Tao, 1994).

The tables and bar graphs reveal, to some extent, the existence of difficulties with the use of everyday words in the physics context for physical science learners in South Africa. The participants in grade 12 also seem to encounter some difficulties in the contextual meanings of everyday words like the grade 11 participants.

In the next section, the researcher will use interviews to investigate the learners' ideas for some of the worst performed words selected earlier. Ideally, it would have been better to analyse all the words but time and space could permit that. The analysis of the teachers' interviews will also be used to investigate the teachers' awareness of the existence of the learners' problem with contextual meanings of some everyday words.

4.5. THE INTERVIEW METHOD: LEARNERS

There were some words that were not difficult to most learners across all the schools. Such words do not have an asterisk mark as illustrated in Table 4.1. However, there were words that had low scores in certain schools only, not all schools. These are the words that 50% or more of the participants were getting them incorrect in that school.

As explained earlier in chapter 3 (Actual data collection section), the researcher interviewed all the learner participants (grade 11 and 12) soon after the questionnaires were marked and analysed in order to investigate the learners' understanding of the contextual meanings of these everyday words. As explained in section 4.2, the targeted questions of the interview were mainly the poorly performed items. The Questionnaire is available on Appendix A and the full learner interview transcripts for all schools are available in Appendix C.

Certain words considered to be *moderately difficult* affected some schools, accounting to a total of 40% or less of the participants when added up. This was a percentage that did not qualify these words to be classified as universally difficult. Such words are analysed first and then followed by the most difficult words in the next section.

4.5.1. *The moderately difficult words*

1. *The word 'Efficient'*

This word is in the questionnaire item number 5 and it reads as follows:

The electrician fits the water heater in the most efficient position. This means she fits it in

A. the easiest position
B. the commonest position
C. the best position
D. the least likely position

The only school that found this word to be difficult is school M where 18 out of 31 participants got it wrong. There were 11 who chose the answer B, (meaning the commonest position) 6 chose D (the least likely position) and 1 chose A (the easiest position).

The participants were asked about this word in their interview and they said they had used the word in the subject called Life Science, not in physical science. The following excerpt supports this:

> L3: Sir, I heard it in Life Science……
>
> R: Okay, in Life Science……?
>
> L3: …Yes when Mr. #### explains about……
>
> R: …Oh, you have a teacher called Mr. #### in Life Science?
>
> L3: …..Yes, he says that the alveoli walls are made for efficient gaseous exchange or diffusion….

It was not easy to have the learners explaining the reason why 11 of them chose the answer B.

2. ***The word 'Negligible'***

This word is in the questionnaire item number 19 and it reads as follows:

After studying various conditions that may affect the time taken for a stone to fall from a fixed height, the pupil concluded that the effect of air resistance was negligible. This means that the pupil felt that air resistance

A. was the only factor operating
B. was most important factor
C. needs not to be taken into account
D. was the first factor to operate

Two schools found this word to be difficult to them according to the criteria used in this study, schools D and M. The school D had 18 out of 27 getting it wrong whilst school M had 19 out of 31 getting it wrong.

Only school D was asked about this word during the interview. They confessed that they did not know the meaning of the word. This is supported by the following excerpt:

R: Do you know the meaning of this word…..negligible…

All: No!

R: Some people are saying 'No'……Who is saying yes… (Prolonged silence)

3. ***The word 'Concept'***

This word is in the questionnaire item number 21 and it reads as follows:

Working through many exercises improved the pupil's concept of Newton's Second Law of motion. This means the pupil's

A. issue improved
B. design improved
C. idea improved
D. method improved.

It was only school D that got 17 out of 27 learners having wrong choices and this translates to 63%. This is above the threshold of 60% used in the criteria.

The other two words worth noting are *consistent* (item number 8) and *evaluate* (item number 9). School D had 17 out 27 learners in each of these items getting wrong choices.

It follows that school D had difficulties in 11 out of the 25 words in the questionnaire. School M had difficulties with 7 out 25 words. The other schools had 5 or less. This means that School D experienced difficulties in most words compared to other schools. This finding may confirm the fact that the learners from school D are mostly from poor backgrounds and that

their proficiency in the language of teaching and learning is 'low'. This is supported by the fact that they preferred to discuss in their indigenous languages during the interview.

The next part of this study is concerned with making detailed analysis of each of the 6 most difficult words.

4.5.2. *The most difficult words*

1. *The word 'Sensitive'*

This word is in the questionnaire item number 5 and it reads as follows:

The beam balance is a very sensitive instrument. This means that it

A. can be used to measure very small things
B. can only be used by sensitive people
C. it is hard to understand how it works
D. gets spoilt very easily

There were 86% (72/84) of grade 11 participants and 71% (15/21) of grade 12 participants who got this word wrong. Out of the 72 incorrect answers in grade 11, there was a staggering 59 participants (82%) who chose the answer D-which refers to the meaning of the word sensitive as "gets spoilt very easily". A smaller number of the participants (13) presented a mixture of different answers consisting of 5 who chose B ("can only be used by sensitive people"), 8 who chose C ("it is hard to understand how it works"). The correct answer to this item was A: "can be used to measure very small things".

The high number of participants choosing D in this item, an incorrect answer with such consistency, signified that the meaning of the word prompted the researcher to select the word *sensitive* is ..."gets spoilt very easily" to them. During the interview, some respondents who chose the answer D were saying that it the word *sensitive* refers to ".....something *fragile*.....something that can break up easily". In the following excerpt, participants in school D argued about the everyday meaning of this word without taking into consideration its meaning in the physics context.

L18: It means fragile

R: It means fragile? Do you agree with him?

L7: What is the meaning of fragile?

R: Look, someone is asking for the meaning of fragile…What is fragile to you? Can you explain for us please?

L18: Something that needs to be well protected…

R: Something that needs to be well protected, okay….where have you used this word before?

All: English!!

R: English…? Not in Physical Science? Hawu! (Gosh!). You have not met this word in physical science….I'm surprised! Alright, when you first met that word, did the teacher explained it?..... (Silence)…… Or that you learnt it by yourselves?

All: ……By ourselves…

In this except, they take the meaning of the word *sensitive* which they met in English language lessons. This implies that it was not familiar to them in the science context. (Category W).

In school Q with grade 12 participant learners gave the contextual meaning of the word *sensitive* to mean "*precious*" to them. The source of the students' ideas about the meaning of this word fell on category X and some on category U.

R: The word sensitive…….Err….Is this word actually familiar to you? Have you used it before?

All: Yes!

R: What does it mean actually….?

All: (mumbling inaudibly)

L1: Precious

R: It means precious?

L1: Yes!

R: Where do you normally use this word? In everyday life? Eh?

L2: Some people use it in…… (Inaudible)……something about precious

R: So it means precious? What about you? (Interviewer referring to another learner)….Eh what does it mean to you?

L2: It's about emotions, actually……(inaudible)

R: Uhhmmm?..... but many of you chose the meaning " getting spoilt easily" in their answers. Do you agree with that? Ehhh?

All: ….Yes! No! …… (Mixed opposing answers)

R: But why say it means "getting spoilt easily"? Is it similar?

L1: It is…..! (Learner reaffirming her answer)

R: Is it almost the same? And, in Physical science, have you encountered this word?

All: Yes!

R: Where in Physical science?

L3: When you talk about how to measure something…. You know where it says…….to measure with a scale……

The school Q's participants (Grade 12) had 15 incorrect choices of which 14 went for the answer D and only one chose the answer B. It is interesting to note that the ones who chose the answer D had the same reasoning as the grade 11 participants in other schools saying that "....*sensitive* is about being *fragile*". How, then, could 73 of the 87 participant's wrong answers be the same and the reasoning behind such a choice be consistent? The participants were defending their answers with confidence. Some learners did agree that they once came across the word in Physics lessons where they were dealing with measuring instruments but their teachers did not explain its meaning. However, little did it occur to them that it was not sufficient to know the general meaning of the word- but, to know how and where it is used, that is, the contextual meaning of the *'word'*. The learners had no difficulty in considered the meaning of the word in the general sense but failed to connect it to the science context.

During the discussion, the researcher did not tell the learner participants the answer to the item being discussed initially in order to allow the learners to talk. This is what enabled the participants to defend the answers they had selected when answering the questionnaire, regardless of whether it was wrong or not. The correct answer was given to the participants in some instances, not all of them, depending on certain prevailing circumstances. Consequently, the participants always thought they were right in most cases.

In very few circumstances, the learner participants who knew the correct answer managed to dominate the discussion, convincing the rest of the group. This immediately quelled the discussion, forcing the researcher to move to the next item of discussion. An example of this occurred with school N participants in the following excerpt:

> R: Do you actually know the meaning of this word? ……..What's the meaning of this word, guys?
>
> L6: Something that you cannot use in a rough way…it gets spoilt….or if it's a device, it gets destroyed.
>
> R: So do you think that if you are using a triple beam balance, it gets destroyed ….is it so?
>
> L6: Eh, if you put it in a stationary position, it can fall over.
>
> R: okay, what about other people? What do you think about this one? Do you all agree about it? Okay….and have you ever met this word before in Physical Science?
>
> All: No!!
>
> R: Someone said "yes". So, is this the first time that you see its use in Physics?
>
> All: Yes!

R: Okay…Fine. Let's go to question number 6…….

In another interesting turn of events, some participant learners said they first met the word outside the science classroom, at home, where they say albinos are *fragile* people. This apparently came from the fact that they are sensitive people. However, the researcher was not able to get more detailed reasons why the albinos were considered to be *fragile* in nature/ society. This occurred in school L- the source of the meaning of the word falls into category X as supported by the following excerpt:

R: Do you know the meaning of the word sensitive?

All: YES!!!!

R: Ohhh! The Yes is everywhere! Okay what is the meaning of sensitive?

L9: Something fragile, something that can easily break……

R: Fragile…….easily break……..Who else can give me a different term or you are going with him all of you?

All: Yes

R: Okay, something fragile, something that can easily break

R: When do you use this word, at home?

L9: At home, with people

R: What kinds of people are fragile? (Commotion, learners talking to each other with interest)

L9: Albinos…!

2. *The word 'Valid'*

This word is in the questionnaire item number 6 and it reads as follows:

The teacher felt that the learners' interpretation of experiment was valid. This means the Teacher felt it was

A. worthless
B. not correct
C. brief
D. sound

This was another very interesting item in terms of the responses obtained during the discussions. The same number of grade 11 participants like in item 5, saw 72 of them choosing an incorrect answer. These wrong choices comprised of 15 selecting A (meaning, *worthless*), another 15 choosing the answer B (meaning *not correct*) and 42 falling for C (meaning *brief*). This implies that the most popular wrong answer (C) to this item was

supported by 58% of the participants. The grade 12 participants had 11 wrong answers with 10 going for C and 1 choosing A.

During the interview, participants gave interesting explanations to their wrong answers, where they suggested that the word *valid* to them meant ".....the opposite of *invalid*, which is like the pin code of a cell phone or card. If it is wrong, it says invalid". The excerpt below is extracted from the interview in school Q:

> R: You know this word valid……..you have met it before…? Have you used it before…sir (Pointing at learner L4)
>
> L4: Yes
>
> R: Where?
>
> L4: In writing a scientific experiment…..you say it is valid.
>
> R: Eeehm! What about other people? Where have you used this word before?
>
> L5: In a cell phone…..when you put a pin number it says valid and when it is wrong it says invalid
>
> R: 'Ehmmm'…….. It says invalid
>
> All: Yes….!

The majority of the incorrect answers to this item chose the meaning of the word *valid* as *brief*. The researcher was interested to know why the participants were choosing this meaning and in school L, an interesting answer was suggested. The participants suggested that the pin or code of cards and cell phones consist of a few characters (letters or numbers) - so the term *brief* meant something small or short! The excerpt below illustrates the discussion in school L:

> L5: It means "brief".
>
> R: You think that it is the correct answer, but is that the actual meaning of the word valid? How did you come to associate that meaning to this word?
>
> L6: Something valid is like a short correct answer....a brief answer....like the pin of a credit card or cell phone. If...sir ...it is not correct...it is invalid.
>
> All: Yah!.....Yes....
>
> L7: All pin codes are three or four numbers or letters.

The participants were using the everyday meaning of a word in this situation (category X). They did not consider the contextual meaning of the word in science. This also implies that they were deriving the meaning from the *street talk* (Jacobs, 1989).

In two schools (school D and N), some learners vehemently opposed those who selected the correct answer D, which referred to the meaning of the word *valid* as *sound*. There were heated arguments, many of them opposing this correct answer. In school D, one learner tried in vain to explain that the contextual meaning of the word valid was sound using isiZulu, her home language. The majority of the other participant learners were not convinced as illustrated in the excerpt that follows for school D:

> L3: It means sound….
>
> R: …..Class she says that it means sound……(Learners laughing)….Ehhhh?..Do you agree with her?
>
> All: No…Yes…Noo!
>
> R: Do you think she is mistaken? Doesn't sound go like "Vruuuu….!"…. (Learners laughing)..
>
> L3: No, not that sound….
>
> R: But when I am talking like this, I am producing sound, isn't it……And then you say the sound…is it sensible to you class? Look, they don't agree with you lady….
>
> L3: Not that sound, ngisho ukuthi uyayi andastenda, hayi ukuthi uyayizwa..(I mean that you it understand, not that you hear it).
>
> R: Uyizwa kanjani? Enqondweni zakho iyakhuluma? (How do you understand it? Does it talk in your head? (Learners laughing)
>
> L3: Ngithi lento iya andastendeka…hayi ukuthi uyayizwa (I'm saying that this is understandable not that you are hearing it….
>
> R: Okay….now we understand it Okay, what do you see now, some words are funny, ' Neh?' At one time they mean one thing and another time another thing. In fact, the correct answer there is "sound". Is it not interesting?

The researcher was deliberately enticing the participant learners to take part in the debate, encouraging the quite ones as well.

3. *The word 'Contract'*

This word is in the questionnaire item number 15 and it reads as follows:

> The experiment was designed to prove that the brass rod would contract as the temperature fell. This means the rod would
> A. change colour
> B. become harder
> C. become shorter
> D. become longer

There were 65 Grade 11 participants who chose the incorrect answers to this item for the meaning of the word *contract*. There were 15 who chose A (meaning to 'change colour'), 27 chose B (meaning to 'become harder') and 23 selecting D (meaning to 'become longer').

This gives a percentage value of 77% of the grade 11 participants getting this item wrong. However, there was no clear trend in terms of the most popular incorrect choice. This suggests that many learners did not know the meaning of this word. For the grade 12 participants, a total of 8 got the item wrong, with 4 choosing B, then 2 choosing A and another 2 selecting D. Again the learners had to justify their choices during the interview. It was interesting to note that the learners would confidently stand by their answers even if they were wrong. When they were given the correct answer, they would look surprised and demanded an explanation.

It was surprising to the researcher that many of the learner participants said that they met the word in other subjects, like Life Sciences, not in Physical Science. They said that they encountered the word in the explanations of the breathing process, where the chest cavity *contracts* and *expands* for the exhalation and inhalation processes. In schools L, D and M preferred to explain the word *contract* by using the knowledge they gained in Life science on the changes in volume of the chest cavity during the breathing process. It was left for the teachers to confirm this. School D and M had the same justification. The following excerpt is part of school D's interview discussion:

> R: Let's start by the meaning of this word……
>
> L8: combine…..(Signalling with hands squeezing action)
>
> R: Combine….Ehh?...to put together, Neh? Ehh, to other people, what does the word contract mean to you? The ladies…..you are very quiet…(further silence)…..you have never seen this word before….never heard of it before?....
>
> L9: Life Science…
>
> R: Life Science? Which particular topic or area……what were you talking about in that area?
>
> L9: ……The lungs…..
>
> R: Okay, what do the lungs do?
>
> L9: They contract…..
>
> R: What will they be doing when they contract…..?
>
> L9: They come closer…….……There is cavity change……

This excerpt shows that the participants reasoning was influenced by what they learn from Life Science (category W), a very popular subject that is closer to everyday life situations they experience and less abstract compared to physics.

Now, for the other participants chose the answer D, which would mean that *contract* means to *become harder* they justified it in a funny but convincing way. They said that because the word contract means "to come together' or "to come closer", then becoming harder was the correct answer. This is probably derived from the changes in size of the chest cavity during the breathing process. In school Q, where the researcher expected a higher level of maturity, one learner suggested that contraction is similar to an inflated balloon being rubbed. He said the rubbing heated the balloon but the balloon became smaller!

4. *The word 'Convention'*

This word is in the questionnaire item number 20 and it reads as follows:

> By convention, electric current flows from the positive terminal to the negative terminal of a battery. This means that this direction of flow
>
> A. has been accepted as an agreed practice
> B. was developed as electricity was discovered a long time ago
> C. has been arrived at but is still not accepted by everybody
> D. is a result of a Physics formula

In this item, 62% (52/84) selected incorrect answers as the meaning of the word *convention*, comprising of 21 participants choosing B (meaning it 'was developed as electricity was discovered a long time ago'), 3 choosing C (meaning that it 'has been arrived at but is still not accepted by everybody') and 28 choosing D (meaning that it 'is a result of a physics formula'). The grade 12 participants had 8 incorrect choices, consisting of 5 choosing B and 3 choosing D. This clearly shows that the most popular incorrect choices were B and D.

This further proves that learners have problems with the meanings of certain words in the science context. They bring in their previous knowledge into the science classroom to try and explain new situations. In such situations, they misinterpret the meanings of words as applied in the science context. The following excerpt (School L) shows the confusion that the learners experience despite having met the particular word before:

> R: What does the word convention mean to you?
>
> L5: Sir, ...it means something well accepted by many people.....like rules of a game.....
>
> L8: Noo! It is not...it means something about Physics, like a formula of Ohms Law (V = I x R) that can be used to calculate current flowing in .....a ....in a ...where the battery is connected....
>
> R: What about others, do you agree with him?

L7: No, sir.....when you are connecting a...circuit, you show where the current is moving with an arrow....from positive to negative and then you calculate the current using the equation....using the formula....

L5: But....it does not mean...that...it is an agreement....

R: Where did you first use this word?.....in which topic and subject...?

L8: ...(shouting)....In Electric circuits....Physics with Mr #####.....

R: Okay...Okay! Did your teacher explain the meaning of the word...?

L7: No..... But...He told us that there conventional direction..... And this is opposite to flow of electrons.....

All: Yesss!

In this excerpt, the participants have met the word before in electric circuits, but the teacher did not explain the meaning. Consequently, in this item some learners confuse it with the Ohms Law formula. In school Q, the participants had a good and mature explanation to the meaning but later the discussion was affected by the presence of their physical science teacher who had just walked into the classroom. They kept on looking at him each time the researcher asked whether he explained the meaning of the word *convention*. The excerpt below describes this moment during the interview at school Q:

L14: Ya…convention… it means changing

R: It means changing….? So that's how the teacher explained it?

L14: Ya!

All: …(Learners glancing at their teacher seated behind them and smiling)….

R: Don't look at him! (Learners laugh and the teacher walks out of the classroom)

L14: That is actually my understanding of the word!

R: No problem, I just wanted to know whether the teacher explains the words or not so that I can see where to pick up the meaning of the word.

5. *The word 'Disintegrate'*

This word is in the questionnaire item number 23 and it reads as follows:

When the sample is heated for too long, it disintegrates. This means that it

A. disappears
B. changes colour
C. break up into smaller pieces
D. dries out rapidly

In grade 11, out of the 51 wrong answers, 19 were for the answer A (meaning that it 'disappears'), 15 for B (meaning that it 'changes colour') and 17 were for the answer D (meaning that it 'dries out rapidly'). For grade 12, 11 were incorrect, where 9 choose A, 1 selected B and 1 selected D. The correct answer to the contextual meaning of the word

"disintegrate" is C meaning "...breaks up into smaller pieces...." It was not easy for the researcher in this item to get the participants' ideas. This word appeared to be new to most of them. In checking the syllabus, the word would have been part of radio activity, a chapter that was *recently* discontinued in the yearly refinement of the new CAPS syllabus.

The majority confessed to hearing about the word *disintegrate* for the first time. Others suggested the meaning that they derived from the subject called Life Science, where they studied about the uterus lining *disintegrating* after ovulation and others from mathematics. However, a participant in school Q remembered word being used in the chemistry section but the teacher did not provide the meaning. As a result, some learners associated the disintegration process to disappearance in chemical reactions. The following except is an extract from the school Q interview:

R: Have you met this word before?

All: Yes! No! Never!

R: Okay, Never or Yes? Let's start with those who say they have used it before…..

L15: In Life science….

R: What were you talking about in Life science?

L15: The uterus wall disintegrating…..

R: Ohhh, the uterus wall disintegrating! What about in Physics, you seem to be running away from Physics. You also mentioned Social Science before……So what does this word mean in Physics for those who say they have met this word before.

L15: It means to breakdown

R: To breakdown. Many of you said it means to 'disappear'. Did your teacher explain it?

L10: Personally, I was never taught this word by any science teacher……it's something I relate to integrate….which means to bring together…..so the opposite would be to …..and in Physical science I remember in the reaction of magnesium the teacher said that it was disintegrating in the acid

R: So….it does disappear…?

L10: Ehhh, it does disappear, eventually…

R: So it disappears?

L10: Yes…

6. *The word 'Adjacent'*

The word *adjacent* will be the last one to be analysed out of the 6 selected words. This word is in the questionnaire item number 25 and it reads as follows:

The student marked the adjacent crests of the wave. This means that the crests were

A. Next to each other
B. Opposite each other
C. As far apart as possible
D. Identical in every way

In grade 11, out of the 58 wrong answers, 36 selected the answer B (meaning "opposite each other"), 16 for D (meaning that it 'changes colour') and 6 selected the answer C (as far apart as possible). For grade 12, only three were incorrect, and they all selected the answer B. The correct answer to the contextual meaning of the word *"adjacent"* is A which means "next to each other". The total number of learners (both grades selecting B were 39 out of the 61 incorrect choices. Such consistency is very strange. The learners were probably misled by the fact that the two nearest crests appear to be symmetrically side by side.

The two schools interviewed concerning the meaning of this word were schools D and N. In both schools, the participants linked the word to Mathematics. The school D learners were very difficult to control since this was the last word for them to be discussed. However, in the case of school D, besides stating that they met the word in mathematics lessons, they appeared to be confused and they mentioned different answers, all similar to the ones in the questionnaire item. The following excerpt illustrates this observation:

L3: It means identical in every way

R: Okay……..it means identical in every way for you…..and then your hand was almost up, sir (Pointing at another learner)

L3: It means opposite to each other…….

4.5.3. *Classifying the learners' meanings of everyday words*

After having analysed the learners' explanations and ideas in the interview, the researcher was able to identify 6 simple categories for classifying the sources of the participant learners' ideas or alternative meanings of the most difficult words. Table 4.4 shows the summary of the categories used.

As an example, in the case of the word *sensitive*, the learners considered its meaning in relation to what they studied in English language lessons. This implies that it was not familiar for them in the physical science context and can thus be classified as Category W. In many instances like the excerpt at the start of this section, learners related words to what they learnt in Life Science, another popular science subject- this is another example of category W.

The researcher also noted that the participants, who studied Life Science as part of their subject combination, were able to use this to their advantage in Physics. Using their knowledge of Life science, they tried to justify the answers they produced for this item. The excerpt that follows (School L) confirms this:

R: What is the meaning of the word "disintegrate" to you

L8: I did not know this word and I guessed my answer...

L7: Me too!.....(Laughing)...

L5: Sir, it means to break up .....

R: Do you agree that it means to break up, class?.....(prolonged silence)...Have you met this word before in class?.....(further silence).....Okay...does it mean that this is the first time you see this word?

All: Yes.....!

L5: I met it when I was reading about the womb of a woman during menstruation.....its lining disintegrates or breakdown.....in Life Science...

L8: Okay....Yes...in Life Science, not in Physics.....Yah..!

R: So, Did your teacher explain the meaning of this word..?

L5: I do not remember but I checked my dictionary for the meaning when I was studying for the cycle test....

Table 4.4: Categories of sources of the learners' alternative word meaning

Category	Description of category
U	Physical science teacher
V	Other subject teachers
W	Other subject textbooks and other readings
X	Out of class/Out of school/Home/'Street lingo'
Y	Phonetic
Z	Word similarity

In school Q, the learners were expected to perform better because they are grade 12, a year ahead of the grade 11, but they gave a different meaning to the word sensitive- saying that it meant "*precious*" to them. The source of the students' ideas about the meaning of this word fell on category X because they associated the word with it every day "street lingo" meaning. In another instance, these learners directly referred to their physical science teacher as the source of the meaning of the word *disintegrate* an example of category U. All the categories summarised in table 4.4 have been represented in different situations and they were revealed

during the interview. The next part of this section presents the analysis of the teacher's views and explanations in relation to their learners' responses.

4.6. THE INTERVIEW METHOD: EDUCATORS

The educators is envisaged as a mediator of learning, as an interpreter and designer of teaching and learning programmes in the new revised CAPS curriculum (Department of Education, 2003). He/she must use language that is understandable to the learners, or at least, help to simplify difficult and confusing terms used during the teaching and learning of science. In this study, the objective of the educator interview was to source data concerning the teacher's influence in the learners' understanding of some everyday words as used in the Physics context. Consequently, the interviews were carried out in order to confirm whether (or not) the ideas the learners have for certain words were a result of the teacher's own explanations. The full text transcripts are available in Appendix D. The researcher will consider the 5 most difficult words for the teacher interview analysis per school. However, it should be noted that in the actual interviews, more words were addressed, inclusive of other contextual issues.

4.6.1. *School D Educator*

The participant teacher in school D was eager to know how his learners performed because he thought that the researcher had given them a test. After assurances that it was a simple questionnaire about the use of everyday words in the physics context, the educator calmed down and the interview started. The educator gave detailed background information about the school and the pupils as explained in the sampling section. However, the only problem was that the time allocated for the researcher was very limited because the teacher had other issues to attend to within the school programme. The researcher (R) had to discuss fewer items than planned with the teacher. The other problem was that the educator (T) was dodgy because he would not directly answer the questions asked. The following excerpt is an example of how difficult it was to interview him:

> R: Now we come to the words that actually gave your learners problems, we want to talk about three or so of them….if you look at question number 5 (giving the teacher a questionnaire paper and reading the question aloud). When I asked them in the interview, they said the word *sensitive* means getting spoilt very easily and I also asked them whether they met this word before in Physical science, some of them said no and some said yes. Then I also asked whether teachers normally explain the words……okay, in your case, do you normally explain such words to your learners?

> T: Look……Eh…we are a school facing many challenges in Physical Science, where we do not have a laboratory, so we find it very hard when we want to do practical experiments and to explain. We do not have the apparatus…..like when we talk about beam balances, it's a challenge to them since they do not know what you are talking about…..

The educator was eager to shift blame and to complain about the learners' background and abilities as well as the school's lack of good infrastructure. A similar finding was also noted in a study by Muralidhar (1991) with Fiji teachers. The issue was about word difficulty for the learners of science which did not require any extra material for the teacher to explain their meaning during the learning and teaching process. The teacher's views belong to category H which is about 'shifting blame and unaware of learners difficulties with contextual meanings of words'.

The researcher also explained the behaviour of this educator in the sampling section together with evidence in the form of excerpts. The learners in turn re-affirmed that their physics teacher did not explain the meanings of the words. This was a clear indicator to the researcher that the teacher at this school was not of the habit of explaining these key words (Category E). He assumed that such words were easy and obvious to learners (Category H).

The researcher also mentioned three other everyday words that the learners appeared to be having problems in understanding their contextual meanings. In response, the teacher accepted that he taught content involving such words and he could not understand the reason why the learners were "…….misunderstanding them this time around" (Category H). When the researcher asked him whether he explained the meanings of such words, he said that he did not do it all the time (Category E). The teacher assumed that some of the words were *"too common*" to be explained and that the others had "been used or known to the learners since grade 10 (Category H).

4.6.2. *School L Educator*

As mentioned earlier in chapter 3 (Data collection section), the interview with the participant educator at school L took place during the lunch break time, on the same day of the learner interview. The teacher also provided valuable information about the school and the learner background.

The researcher started by asking the teacher the meaning of the word *sensitive*. The following excerpt for the teacher of school L is about the meaning of the word *sensitive* (item 5):

R: Ehhmmm…….I would say it means *touchy*… kind of…

R: But some of your learners chose the meaning of the word as " to getting very spoilt easily"…..and others said "….for sensitive people…..". Do you agree with them or not….?

R: No, the word means something touchy… now, to say only sensitive people must use a sensitive thing is farfetched……

R: Have you ever used this word before in your teaching? And, if you can remember the topic in Physical Science, where you used the word with your learners, it would be fine…

T: Ehhhh, I don't remember….

The way the teacher defined it was not comprehensible, but he explained the meaning of the word in terms of a particular context of his own. This is because the researcher did not provide him with the questionnaire paper at the start of the interview. However, when he was given the paper to provide a possible answer for the item, he selected the correct one. Concerning his learners' erroneous definition, he denied being the source of the confusion (Category H).

In the case of the word *valid*, the teacher gave a correct definition but was surprised to hear that his learners preferred to refer to the meaning of the word as brief. The excerpt below supports his point of view:

R: Okay……according to your own understanding, what does the word *valid* mean to you?

T: Ehhhmm, I think I would mean "tried and tested", "correct" or "something that is generally accepted"

R: Your learners said the word *valid* means *brief*. Do you agree with them?

T: I don't …..

R: Why, they are your learners, you teach them…..

T: Wait, Wait! Yes……they are my learners but I do not think I have ever taught them *valid* as *brief*……

R: Where do you think they pick this meaning from?

T: You know learners, even if you teach them something correct, they prefer to use words that are popular or cool with them, like the one they use for internet texting

The teacher preferred to shift the blame and suggested that cell phone texting and the 'cool' street lingo that learners used whenever they communicate with each other affect their understanding of English words in the science classroom (Category H). The researcher then further probed him about the reasons why he did not explain the meanings of the words. He

claimed that he only explained words only in deserving situations and when the learners ask him. Here is what he had to say to explain his views:

> T: Ahhm……..I wouldn't say, yes I explain such words always….
>
> R: Why don't do that?
>
> T: I can't say that every lecture (Lesson) I have to explain words to them…. You know with Physical science, we don't have time on our side…..okay….you are not finishing what you want to teach…but of the times they know…..
>
> R: But, don't you think it is important?
>
> T: Yah, it is important…and if they ask yes, I explain……
>
> R: What do you think teachers must do, should they take it for granted that they (learners) know and progress?
>
> T: No, I don't……I don't agree with that.
>
> R: In future, are you going to (take this seriously) explain the (contextual) meanings of the words?
>
> T: Yes of course, I've always been doing that but not very much…

In the researcher's opinion, this teacher was not aware of his leaners' problems with the contextual meanings of every word when they are used in science. In reality, it surprised him to learn that they had such problems (Categories E, F and I).

4.6.3. *School M Educator*

The teacher in this school had similar views as the other teacher in school L. When it came to the actual interview, the educator, in most instances expressed surprise that his learners could fail to understand some words which he assumed to be simple and obvious (Category I). The following excerpt (in relation to item 5) shows how the teacher disagrees with the way his learners explained the contextual meaning of the word *sensitive*:

> R: Okay, many of your learners actually said, the meaning of the word *sensitive* is....."getting spoilt very easily". Do you agree with your learners in terms of the definition of this word?
>
> T: (Silence)....No!
>
> R: Why don't you agree with them?
>
> T: Because it's not what I taught them...it's not the way how we used the word *sensitive* in my class.....
>
> R: Okay...so are you are talking in terms of your subject or in general
>
> T: In terms of my subject.....
>
> R: Tell me which sections or topics of your subject did you use such a word.

T: We were dealing with vectors and forces, where we had to do a practical (experiment) ...we had to take very accurate measurements …..

The teacher however agreed that he occasionally used words without explaining their meaning to the learners because he assumed that the learners knew their meanings (Category F). In the following excerpt, the teacher was referring to the word *sensitive*, which he claims to have explained to his learners in an experiment:

R: Do you normally explain or provide any meaning to the words to your learners...like the one you have just explained...?

T: In some instances I do, but not all the time. I cannot say I explain. There are terms that are particular or new to- or specific to the topic -that aren't generally derived from the situation.

R: So it generally depends on you, when you feel that you need to explain?

T: Yes.

When the researcher further probed about when the teacher chose to explain term, he confessed to the fact that he considered some of the words to be too general to be explained and that it was not easy to judge when to explain certain words. The following excerpt confirms tis observation:

T: It is very difficult and I can't say…..or perhaps a moment whereby I sat down and picked out a few general words because .....but by virtue of the fact that they are general, one automatically assumes that they would know them.....not to spent 3 or 4 minutes of the lesson explaining the words...

The teacher confessed that he had no idea why learners gave strange definitions to certain words despite the fact that he used such words occasionally in his lessons. This implies that the teacher was surprised about such a finding and it was an 'eye opener' to him (Category I). What appeared to be simple to him was not simple for the learners. The following excerpt is another example of what the researcher can call an 'eye opener':

R: Alright, many of your learners said that the meaning of the word "valid" is "brief". Do you agree with them?

T: That is way off!

R: Way off? (What do you mean?)

T: Noooo! Ahhh? (Expressing disbelief) There are some words that we do take for granted but I cannot see how one can relate "valid" with "brief". I cannot explain their thinking....Heeh! Heh! (Laughing)

R: So where do you think they pick up such a meaning?

T: Such a number of them....valid for brief? No I...I cannot talk for them.

Besides explaining the words, the teacher provided back ground information about the school. The laboratories were not in a good state and but the sizes of the classes were manageable, about 32 to 35. He was concerned about the learners' proficiency in English. He said that they could not express themselves properly. This statement about poor proficiency in English at this school corroborates the fact that the learners poorer scores (second worst) compared to other schools in answering questionnaire items. The following excerpt summaries how the teacher provided valuable background data about this school.

R: Are you happy about the….. (sizes of the classes)….And the numbers?

T: I think I am okay, 30 to 32...

R: So they are manageable?

T: Yes

R: The Laboratories, are they well equipped?

T: No, Laboratories need to be looked into….I am not happy with them

R: And now, finally, do you think your learners are proficient in English……..?

T: No, they are not...maybe they are in what you call 'modern lingua' but that is not English to me....

R: So they cannot express themselves well?

T: They can't express themselves well, and when they write it not up to standard...

4.6.4. *School N Educator*

The educator in this school provided background information. He said that that they are mostly from the poor '*location*' suburbs and that ill-discipline was a norm in the school but could not explain the real reason behind the rowdy character of the learners. The school's pass rate was in the mid-80s every year. There are laboratories at the school despite the fact that they are not well equipped. The researcher could not understand the reason why these learners were so ill disciplined but perform well academically. Their scores in the questionnaire were equally not bad.

The teacher in this school was in his fourth year of teaching experience (the youngest of the 5 interviewed). He had a tendency of being defensive and making lengthy explanations to interview questions. The interviewer was compelled to change the way of interviewing the teacher. One of the words explained by the teacher was from item 5, the word *sensitive.*

The following excerpt demonstrates this observation:

R: Let's…..look at question number 5 (Reading it aloud). You have met this word before…..

T: Let me think of the topic…

R: But you have met it before…

T: Many times……Yah, when we were using the pH scale…when we were measuring the pH of the…..(inaudible)….when we were using the pH meter, I told them that the electrodes… the front part of the electrode is very sensitive, it is a very delicate instrument to work with… that would affect the experiment….

R: Many of your learners said that the answer there was "the instrument gets spoilt very easily" ……..

T: No…when we were using it we meant to say, if there is a slight change in the pH of your solution, it would pick it up…they should tell you that the answer is A not D….that's what they need to know…

R: Okay, now if you look at this word…….. Where do your l learners get this meaning?

T: Yah, you have to understand that science has got its own jargon, you know….it's language is quite different from what we are used to…especially in cases like this….eh…in various cases, the words that we were using…they mean something according to what the dictionary is saying…is telling them but in science, it means something else…it's referring to something else, so you have to understand that almost out of 600…5 of them, the meaning in the dictionary…when we say sensitive, it means that….so only when it changes, it becomes a problem…

Not much data in relation to word was obtained from this teacher owing to his way of answering interview questions. The teacher was surprised that his learners were failing to explain some words which appeared "simple and straight forward" (Category I). The teacher also mentioned that he explained words whenever he considered it necessary (Category F).

4.6.5. *School Q Educator*

The teacher in this school was also provided valuable data about the background of the school at the start of the interview. The school was well equipped former 'model C' under a good principal who maintained ran and managed it very well. There are surveillance cameras in all classrooms and corridors to monitor learners and teachers. This echoed well with the good behaviour of the learners and their academic performance. For a moment, the researcher was able to understand why the learners in School N were ill-behaved. The issue of discipline control depends on the management plan directed by the principal in that school.

The teacher was content with his learners' verbal proficiency in the language of instruction (English) but was concerned about the way they answered in written English. The following excerpt confirms the teacher's worries:

R: So are you happy with their command of the English or proficiency as a language of instruction?

T:Yes, but I think there is still need for them to improve….because when you are talking to them "verbally"…they seem to speak good English, but when it comes to writing and understanding, that is something else….

R: Is it "street lingo" or language that is scholarly when they talk?

T: They normally mix up the language…..

The teacher was surprised when told that many of the learners in his class gave the meaning of the word *valid* (item 6) as *brief*. He was dodgy in terms of explaining the origins of his learners' misunderstanding of the word (Category H). The following excerpt confirms his surprise:

R: Okay, a good number of your learners said that this word means brief…

T: …What?!!!...Brief…! (Laughs)

R: Yes…Well, do you agree with them ….?

T: Ehmmm….I do not want to speak for them, because we do not normally speak of these words regularly in class, so I wouldn't know the reasons why they chose that meaning…

R: Did you ever use it before in a particular topic in the teaching of Physical Science…?

T: It is very possible because ….ehhh…sometimes you are marking there, let's say an exercise, then you say, give me a valid reason meant to explain or describe something…then you say your reasoning was not valid…or something like that…

The teacher at this school also agreed that learners can have problems with word meanings despite the fact that the teachers used such words regularly during classes.

R: Surprisingly, some say that this word means….a formula of physics…and other said it means…something that was developed a long time ago….Do you agree with them?

T: ….(Giggling)…. "kids" being "kids"…you may never know what they are thinking of all the time but actually this year we actually spoke about this word when we were doing organic chemistry…

4.6.6. *Classifying the teachers' views and awareness*

The researcher discovered that all the 5 teachers gave views or comments of category H and/or I demonstrating that they were unaware of the learners' problems with the use of everyday words in the physics context. Four of the five teachers tried to distant themselves from their learners' poor explanation of certain contextual meanings of words. They were shifting the blame to the learners themselves. Two of the five educators tried to explain the

source of their learners' alternative meanings of everyday words when used in the physics context. The analysis of the teachers' comments, views and ideas in their interviews can be synthesized into 5 categories. These categories are shown in Table 4.5.

Table 4.5: Categories of teachers' views and awareness

Category	Description of category
E	Does not have a habit of explaining contextual meanings of words to learners
F	Occasionally explains contextual meanings of words to learners
G	Aware and concerned about learners' linguistic problems (contextual meanings)
H	Unaware of learners' linguistic problems but shifting blame to learners or other (contextual meanings)
I	Unaware of learners' linguistic problems but willing to accept blame (contextual meanings)

4.6.7. *Concluding remark*

In this section, teachers' interviews revealed that the teachers were not aware that their learners had difficulties in understanding contextual meanings of simple everyday words. The teachers did not explain the contextual meanings of these words assuming that they were obvious or too "general" or too easy to the learners (School N, L and M teachers). In other instances, the teachers confessed that they did not know (School M and N teachers) when to explain or not to explain such words. This may be the reason why the learners used the meanings of such words taken from outside the physics classroom. The learners are not made are that the simple everyday words they use in other situations would have changed their meanings in a particular context. The learners use the meanings of these words obtained from other subjects like Mathematics and Life Sciences where they are well explained to them by the teachers concerned or the easy to understand language in their textbooks instead.

If ever the teachers explain the meanings of such words, the learners would be made aware or they would know/understand the contextual meanings when used in physics. This fact is extensively argued in the literature review section of this study that the teacher is the cornerstone of the learning process. The teacher is the "main resource or alternative source of ideas of school science. It is teachers' classroom language that enables learners to understand the physics concepts (Oyoo, 2009, p. 170).

4.7. CHAPTER SUMMARY

In this chapter, the data from different sources was presented and analysed in detail. In the next chapter, the researcher will present the findings, implications and limitations of the study.

CHAPTER 5

CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

5.1. CONCLUSION

The study was set to investigate the learners' interpretation of everyday words if such words are used in the physics contexts. This investigation was meant for South African learners who are second language speakers of English, the language of instruction. Literature was reviewed concerning language issues and other related research findings. This laid down the foundation and methodology of this study. A questionnaire and interviews were the methods of data gathering whilst the sample consisted of high school physical science pupils and their teachers. The questionnaire was administered to the learners who were later interviewed. The physical teachers were also interviewed concerning their learners' responses. The findings of the study were directed at answering the following research questions:

- Do South African grade 11 and 12 physical science learners also encounter difficulties with everyday words when used in the Physics context?
- What are the learners' meanings and explanations to some everyday words when used in the Physics context?
- Do the teachers' explanations influence the learners' understanding of some everyday words as used in the Physics context?

The conclusion drawn from results and findings of this research study will provide the answers to these questions. Consequently, the conclusions of this study shed some light on the learners' ideas about everyday words when used in the physics context. The most important findings are summarised in the next section.

5.2. FINDINGS

The findings of the study have shown that high school learners of the 5 schools involved in the study had some difficulties with the use of everyday words in the physics contextual settings. The result of the study showed that the grade 11 learners had lower average percentage score compared to grade 12. This is probably attributed to the fact that the grade 12 level is academically a year ahead of the grade 11 level. Also, the grade 12 sample had more English first language speakers (EFLS) than the rest of the groups. However, despite this academic advantage and none of the grade 12 participant learners obtained a 100% score. This implies that most learners at high school experience problems with the use of everyday

words in the physics context these problems can be influenced by the level of education at high school and level of proficiency in the language of instruction.

When learners encountered certain key everyday words in sentences and explanations, they tended to associate the meaning of the words with their past experiences. As a consequence of this, they used meanings derived from other contexts and, this resulted in learners incorrectly understanding or interpreting physics concepts. In some instances they associate the meanings of such key words with "street lingo" definitions, everyday meanings or meanings derived from other subject areas. This implies that the contextual meanings of such everyday words are not provided to the learners of science by their science/physics teachers during lessons time. This could be a contributing factor to the difficulties learners experience when they learn physics concepts which are already difficult and abstract by their nature. This may also lead to poor performance in the examinations.

The English first language learners (EFL) had a slightly higher (but significant) percentage mean achievement than the second language learners. This implies that it is an advantage to have a higher proficiency in the language of instruction in order to understand the contextual meanings of words compared to the English second language speakers (ESL). However, none of these first language speakers scored 100% in all participating schools. This also implies that the first language speakers also encounter problems with the contextual meanings of these everyday words. As mentioned earlier in the literature review section, the learners' proficiency in the language of instruction is helpful but does not eliminate the difficulties learners experience for them to excel in physics because the physics/science classroom language is a new language to all learners of science (Oyoo, 2008).

Teachers were not aware of their learners' problems when they use everyday words in the science context. The teachers were actually surprised when they discovered that their learners were misunderstanding the contextual meanings of such words which they 'took for granted', considered them as 'too obvious', 'easy' or 'simple' every day words. The way the learners incorrectly explained the meanings of such words was an 'eye opener' for the teachers of physics/science in this research. These finding are similar to those obtained by other researchers in other countries (Gardner, 1971; Tao, 1994; Farrell & Ventura, 1998; Johnstone & Selepeng, 2000; Ismail & Ali, 2006; Oyoo, 2008/2010). This implies that South African learners also have problems with everyday words when used in the physics context.

The researcher considers that all the research questions that were the cornerstone of this study were answered after the results were obtained and analysed.

5.3. IMPLICATIONS OF THE STUDY

This study has shown that learners are experiencing difficulties with everyday words that are part of the science classroom language. It is important for teachers to be aware of such difficulties and that they must not always assume that the learners understand the meanings of all the simple every day words when they are used in the physics/science context. They must concern themselves with explaining all the key words that are used so that the learners are able to understand the physics/science concepts.

If all science teachers are made aware of this problem, they may help their learners in understanding physics/science concepts and hence improve their performance in examinations which is currently poor.

5.4. LIMITATIONS OF THE STUDY

Owing to the constraints of time and financial limitations, this study was confined to a small sample of learners from five high schools in an urban setting and five teachers of Physical Science. If a bigger sample involving rural impoverished communities was used, the results would be more representative of the South African context. According to McMillan and Schumacher (2010), if a greater size of the sample is used, it becomes more representative of that population and this increases the credibility of the research results.

In South Africa, Physics is not offered as a stand-alone subject. It is offered as a combination with Chemistry, thus naming it Physical Science. The standard of the physics content is too high to be offered with chemistry as one subject. As a result, the researcher had difficulties in identifying and using physics specific everyday words in relation to the physical science curriculum.

The other weakness was in the use of grade 11 learners in the sample as the main participants, given the fact that they would not have covered certain key concepts in their Physical Science syllabus. The Grade 12 learners were too busy to be involved in the sample at the time of data collection. Also, the Department of Education discourages the involvement of Grade 12 learners in such research studies.

Another issue was about the science teachers. They were not very co-operative owing to busy schedule and other time constraints in the high school environment. They complained about the Physical Science syllabus which is very long to complete in time such that they had limited time to spare for research studies like this one.

Owing to time constraints, during the learners' interviews, the groups were not sub-divided into smaller sub groups in all schools as initially planned. This move proved very problematic in some schools because of the large numbers of learners in one class doing Physical Science. In other schools, there was a serious problem of ill-discipline. The researcher experienced difficulties in controlling participant learners in such schools.

However, as mentioned earlier, the research had some positive aspects. The teachers involved were surprised about what they used to take for granted during their teaching.

5.5. RECOMMENDATIONS

Despite the fact that the sample was not substantially big enough for generalised recommendations to be made, the researcher advances the following recommendations in order to improve the understanding of physics concepts to the teaching and learning process:

Teachers of physics/science need to be made aware of the difficulties the learners encounter with the contextual meanings of everyday words during subject cluster meetings, workshops and subject meetings. The findings from the teacher interviews suggest that 5 out of the 5 teacher participants (100%) were not aware that the learners they teach had difficulties with the meanings of everyday day words when used the physics context. Some of the participant teachers confessed that they were ignorant of the existence of this problem because they considered the everyday words as too easy/simple/'obvious' to be explained during physics lessons. This implies that teachers considered explaining the technical words in physics to learners more important than the non-technical words.

Some teachers were not of the habit of explaining words which learners did not ask for their meanings, particularly the everyday words. Such teachers expected the learners to be aware of the contextual meanings of such everyday words. On the contrary, the teachers of science must identify and explain all key words that are used in physics/science questions and explanations regardless of whether the learners ask their meanings or not.

The teacher training programmes at colleges and universities should conscientise the trainee teachers or participating of physics/science about the problem of the science classroom language. Textbooks must also highlight such key or cornerstone words and provide a glossary of meanings. Similarly, examiners must highlight such everyday words if they carry a contextual meaning in order to warn the candidates.

If the learners are made aware of the change in meanings of everyday words in the science classroom language in accordance with the context, they will be better prepared.

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APPENDIX A

1. THE QUESTIONNAIRE

The University of the Witwatersrand, Johannesburg, South Africa

Investigating meanings of everyday words used in Physics Context

This questionnaire has questions which are to find your ideas about some words use in School Science. *It is not a test*, so you need not worry about your answers as being right or wrong. Your responses will be kept confidential and anonymous. *Attempt all the questions*. After finishing drop this questionnaire immediately into the collection envelope.
Read each question carefully and think about the underlined word. Put a CIRCLE round the letter (A, B, C or D) as your answer to what you think represents the nearest meaning of the *underlined* word.

1. The sample was weighed at midday on ten *consecutive* days, This means it was weighed
   A. the first and tenth day
   B. Every tenth day
   C. Every day for ten days
   D. Ten times every day

2. The thermos flask is a useful *device* for keeping hot liquids. This means it is
   A. A luxury
   B An appliance
   C. A method
   D. An opportunity

3. The electrician fits the water heater in the most *efficient* position. This means she fits it in
   A. the easiest position
   B. the commonest position
   C. the best position
   D. the least likely position

4. Metals produce a *characteristic* sound when they are struck. This means that metals produce
   A. A nice sound
   B. A sound like any other
   C. A strong sound
   D. A bad sound

5. The beam balance is a very *sensitive* instrument. This means that it
   A. can be used to measure very small things
   B. can only be used by sensitive people
   C. it is hard to understand how it works
   D. gets spoilt very easily

6. The teacher felt that the learners' interpretation of experiment was *valid*. This means the teacher felt it was
   A. worthless
   B. not correct
   C. brief
   D. sound

7. The car's movement was *linear*. This means the car
   A. kept stopping and starting
   B. moved in a straight line
   C. was dangerous
   D. swerved from side to side

8. The results of three experiments were *consistent*. This means the results were
   A. variable
   B. adequate
   C. the same
   D. adjusted

9. Your science teacher said that she was going to *evacuate* the flask. This means the teacher will

   A. empty the flask

   B. close the flask

   C. clean the flask

   D. cools it in a vacuum

10. The students were able to *estimate* the volume of water in the container. This means
   A. they made a careful guess of the volume
   B. measured the volume carefully
   C. poured out some water from the container
   D. filled the container from the tap

11. People are asked to switch off light whenever they leave a room in order to *conserve* energy.
   This means people are asked
   A. to use energy carefully to make it last
   B. to make light brighter on switching on again
   C. to avoid risk of fire
   D. not to make use of light at all

12. The teacher referred to the motion of the solid particles suspended in the water as *random*.
   This means that the motion
   A. was very fast
   B. was starting and stopping
   C. had no order at all
   D. occurred every ten seconds.

13. The speed *limit* for the vehicles was 40km/h. This means that vehicles could travel
   A. at exactly 40km/h
   B. between 45 and 35km/h
   C. at an average speed of 40km/h
   D. at no more than 40km/h

14. Some students were studying the *fundamental* laws of Physics. This means they were studying the
   A. Old laws of Physics
   B. Most important laws of Physics
   C. Modern and newly discovered laws of Physics
   D. Most easily explained laws of Physics

15. The experiment was designed to prove that the brass rod would *contract* as the temperature fell. This means the rod would

A. change colour
B. become harder
C. become shorter
D. become longer

16. The car engine *generates* heat through the burning of petrol. This means it

A. Loses heat
B. Gains heat
C. Produces heat
D. does not need heat

17. When the stone is lowered into a beaker, it *displaces* some water. This means it

A. absorbs some of the water
B. pushes away some water
C. gets bigger
D. simply falls through the water to the bottom of the beaker

18. The pupil knows the *function* of the electric motor. This means she knows

A. how the electric motor is made up
B. what is wrong with the electric motor
C. what influences the electric motor
D. what the electric motor does

19. After studying various conditions that may affect the time taken for a stone to fall from a fixed height, the pupil concluded that the effect of air resistance was *negligible*. This means that the pupil felt that air resistance

A. was the only factor operating
B. was most important factor
C. needs not to be taken into account
D. was the first factor to operate

20. By *convention*, electric current flows from the positive terminal to the negative terminal of a battery. This means that this direction of flow

A. has been accepted as an agreed practice
B. was developed as electricity was discovered a long time ago
C. has been arrived at but is still not accepted by everybody
D. is a result of a Physics formula

21. Working through many exercises improved the pupil's *concept* of Newton's Second Law of motion. This means the pupil's

A. issue improved
B. design improved
C. idea improved
D. method improved.

22. If you were asked to *classify* a collection of metal containers, this means you must

A. clean them
B. count them
C. put them in similar groups
D. paint them neatly

23. When the sample is heated for too long, it *disintegrates*. This means that it
    A. disappears
    B. changes colour
    C. break up into smaller pieces
    D. dries out rapidly

24 The learner knew the *source* of the sound. This means the learner knew
    A. Its loudness
    B. Where it went to
    C. Its pitch
    D. Where it came from

25. The student marked the *adjacent* crests of the wave. This means that the crests were
    A. Next to each other
    B. Opposite each other
    C. As far apart as possible
    D. Identical in every way

Thank you for taking time to answer the questionnaire

2. QUESTIONNAIRE ANSWER SHEET

A. Number……..... **B. Are you Female /Male? (Please circle)**

C. Class/Level……. D. Language used <u>most</u> while at

(i) School……. (ii) Home……

1.	**A**	**B**	**C**	**D**
2.	**A**	**B**	**C**	**D**
3.	**A**	**B**	**C**	**D**
4.	**A**	**B**	**C**	**D**
5.	**A**	**B**	**C**	**D**
6.	**A**	**B**	**C**	**D**
7.	**A**	**B**	**C**	**D**
8.	**A**	**B**	**C**	**D**
9.	**A**	**B**	**C**	**D**
10.	**A**	**B**	**C**	**D**
11.	**A**	**B**	**C**	**D**
12.	**A**	**B**	**C**	**D**
13.	**A**	**B**	**C**	**D**
14.	**A**	**B**	**C**	**D**
15.	**A**	**B**	**C**	**D**
16.	**A**	**B**	**C**	**D**
17.	**A**	**B**	**C**	**D**
18.	**A**	**B**	**C**	**D**
19.	**A**	**B**	**C**	**D**
20.	**A**	**B**	**C**	**D**
21.	**A**	**B**	**C**	**D**
22.	**A**	**B**	**C**	**D**
23.	**A**	**B**	**C**	**D**
24.	**A**	**B**	**C**	**D**
25.	**A**	**B**	**C**	**D**

Thank you for taking time to answer the questionnaire

3. MEMORANDUM OF ANSWERS TO THE QUESTIONNAIRE

A. Number……. **B. Are you Female /Male? (Please circle)**

C. Class/Level……. D. Language used most while at

(i) School……. (ii) Home……

1.	**A**	**B**	**C**	**D**
2.	**A**	**B**	**C**	**D**
3.	**A**	**B**	**C**	**D**
4.	**A**	**B**	**C**	**D**
5.	**A**	**B**	**C**	**D**
6.	**A**	**B**	**C**	**D**
7.	**A**	**B**	**C**	**D**
8.	**A**	**B**	**C**	**D**
9.	**A**	**B**	**C**	**D**
10.	**A**	**B**	**C**	**D**
11.	**A**	**B**	**C**	**D**
12.	**A**	**B**	**C**	**D**
13.	**A**	**B**	**C**	**D**
14.	**A**	**B**	**C**	**D**
15.	**A**	**B**	**C**	**D**
16.	**A**	**B**	**C**	**D**
17.	**A**	**B**	**C**	**D**
18.	**A**	**B**	**C**	**D**
19.	**A**	**B**	**C**	**D**
20.	**A**	**B**	**C**	**D**
21.	**A**	**B**	**C**	**D**
22.	**A**	**B**	**C**	**D**
23.	**A**	**B**	**C**	**D**
24.	**A**	**B**	**C**	**D**
25.	**A**	**B**	**C**	**D**

Thank you for taking time to answer the questionnaire

APPENDIX B

1. LEARNER'S SEMI STRUCTURED INTERVIEW SCHEDULE

After the marking the questionnaire, the following interview guide will be used:

Is the word …… familiar to you? If so, when did you first encounter the word?

……
……

How often have you used the word?
……..Where?.....
……..How?.....

How often do your teachers in the science classrooms use this word? ……

You gave ……., as the meaning of this word. How did you arrive at this meaning?

……
……
……

When did your teacher first use this word in the physical science lessons?
……..

Which topic was being taught?
……

Did the teacher provide its main meaning?
……..

If so, was the main or everyday meaning of this word connected to its meaning in the science context?
……
……

Can you state an aspect of that lesson that made you to attach the answer you gave as the meaning of the word?
……
……
……

Do you have any other reason for having selected …….. as the meaning of this word?
……
……
……

Thank you for your voluntary participation in the interview

2. TEACHER'S SEMI-STRUCTURED INTERVIEW SCHEDULE

This semi structured schedule will be used to interview teachers after the analysis of the learners' responses. The interview questions may change, or, may be re-designed depending on the learners' responses. The questions will be structured to access the teacher's opinion concerning the learners' explanations.

What does the word …… mean to you?
……
……
Many of your learners gave ……. as the meaning of this word. Do you agree with their definition? Why?

……
……
……

Which topics or sections do you normally use this word in your science lessons?
……
…….

Do you normally explain or provide the meaning of this word to your learners?
……
……
……

Do you explain the word in connection to the science context or its everyday meaning?
……
……
……

NB: This schedule is the interview of the teachers after the marking of the items on the questionnaire. The actual interview questions will be designed on the ground during the data collection session and the content per teacher will not necessarily be the same.

These, however will be dependent on the general performance of the learners on a particular word or a uniquely performed word; the interview questions will be structured to access the teacher's opinion on/explanations of these performances on the questionnaire items. Also, the teacher's opinions will be sought on how learner knowledge of such words can be enhanced.

Thank you for your voluntary participation in the interview

APPENDIX C:

LEARNER INTERVIEW TRANSCRIPTS

1. LEARNER INTERVIEW (SCHOOL D)

Key: "L" represents the Learner interviewee; "ALL" represents all or most of the learner interviewees and "I" stands for the Interviewer

I:Do not be shy people……We will start by looking at question number 25. Right….. at the last part of the page….. The last one …. Right at the last page…. question number 25. Remember, you don't write on those papers because we are going to re-use them. The question reads as follows.

The student marked adjacent crests of the wave. This means that the crests were ……..

The word that has been is what?.....

All: Adjacent!

I: Okay…...Do you know the meaning of this word? What does adjacent mean to you? Whether you are wrong or right, you have some meaning of this word of some sort. What does this word mean to you?.....Eh?..... Who is the ice breaker (Interviewer trying to coerce the learners to respond)…….you can khuluma ngesizulu (speak in Zulu), no problem …….(prolonged silence)……..Yes sir…..It means what?

L1: It means to extend…..

I: It means to extend……..?

L1: Yes to extend

I: Okay what about other people what does the word mean? Have you ever met this word before?

All: Yes!

I: Where did you meet it?.....in what?

All: Mathematics!

I: Mathematics…..? Can someone give me an example to say……okay, here they use it like that…in mathematics…….(prolonged silence)…Ehhh? What adjacent thing is it?…..this guy said it means to extend and the other said that you used the word in mathematics…….is it only in mathematics?.....you have never met it in physics……grade 10…….grade 11?.....to some of you, this is the first time you see this word?

All: No!

I: Okay, you……. (Pointing at one learner) had your hand up, do want to give us the meaning of this word?

L2: It means identical in every way

I: Okay……..it means identical in every way for you…..and then your hand was almost up, sir (Pointing at another learner)

L3: It means opposite to each other…….

I: Okay… opposite each other……right. (Learners slowly opening up and politely raising up their hands) I am going to one last one from a lady……..

L4: ……Next to each other…..

I: …..she says…..for her……it means next to each other. Who is agreeing with her? According to my answer, it means A: next to each other. And then the other question was question number 24……. Where a number of you gave me some odd answers that…. The question says:

The learner knew the source of the sound. This means the learner knew…….

Okay……do you know the meaning of this word? Ehhh?...Let's start with the meaning of it…What does it mean? Ehhh?

L5: Origin

I: Origin….? Oh, someone else…..someone else….(prolonged silence)…So everyone agrees with that?

All: Yes!

I: Okay…..now…. where did you first use this word?

L3: Life Science….

L5: Social Science….

L3: Geography…

I: Alright……..and then….when you met that word for the first time in Geography or Social Science, did the teachers explain its meaning first?

All: No….

I: They don't explain- they just talk..

L6: They do explain…

I: Okay, some explain and some don't…..is it? Why don't they explain? …..Ehhh?.....(Prolonged silence)…..you don't know?

All: …..(with hushed voices)…….Uhmmm

I: You do not know?..... You have no idea why they do not explain these words?.....(silence). Alright, the answer there was "D", where it came from….Another problematic question was question number 19…….Let's all go to question number 19…….(The interview is interrupted by another teacher who walks in without knocking or asking for permission and sat down in a chair and tells the interviewer that it was her period)……..There is prolonged silence……

Teacher: Class, I am not feeling well…I won't be seeing you now…okay

I: Okay, let's continue…….we had said question what…..?

All: Question 19!!

I: ……(reading)……

After studying various conditions that may affect the time taken for a stone to fall from a fixed height, the pupil concluded that the effect of air resistance was negligible…….

Do you know the meaning of this word…..negligible…

All: No!

R: .....Some people are saying 'No'……Who is saying yes….What do you think it means?

L7: It means not to be taken into account. ….

I: You think it means not to be taken into account…..?

L7: Yes

I: Okay…Do you agree with him that it means not to be taken into account?

All: Yes!

I: Alright, when did you first meet this word before? If it is in Physical Science, maybe, you can tell me the topic…(Prolonged silence)…..Is it the first time you meet this word? Ehhh?

L3: … (faintly speaking)…...Physical science…..

I: In Physical Science…….where, which topic?

L3: I said never in Physical science……

I: …..(Laughing)…..You are back-tracking…..The other people say that you have never met it before……..(mumbling sounds from learners)……Okay…..The answer was "Not to be taken into account"…..Another question that pupils had a problem with was question number 15……Question 15…..are we all there?

The experiment was to prove that the brass rod would <u>contract</u> when cooled. This means that the rod would……..

Let's start by the meaning of this word……What does this word mean to you? You know what it means but it is difficult for you to say it...Yes?

L8: combine…..(Signalling with hands squeezing action)

I: Combine….Ehh?...to put together, Neh? Ehh, to other people, what does the word contract mean to you? The ladies…..you are very quiet…(further silence)…..you have never seen this word before….never heard of it before?.....Oh, you have....?Which….which….Ehhh….In what?...

L9: Life Science…

I: Life Science? Which particular topic or area……what were you talking about in that area? Were you talking about the stomach…..or the gaseous exchange…..

L9: ……The lungs…..

I: Okay, what do the lungs do?

L9: They contract…..

I: What will they be doing when they contract…..?

L9: They come closer…….……There is cavity change……

I: Okay, for you contract means coming closer?.....(Nodding head to show acceptance)…….Aha.., you see….He is explaining something using Life Science……Change in size…..……Do you agree with him?

All: Yes

I: ……..You see that you can relate words to situations…….. Did the teacher explain the meaning of the word…….

All: No…

I: So how did you know the meaning of the word?

L10: You can tell by reading the sentence…..

I: But now, why is it that when you put it in other sentences you do not get the correct answer? Ok, then the answer to the question was "to become smaller"……The other question that was problematic was question number 14……for some…..Okay, number 14 say that:

The students were studying the <u>fundamental</u> laws of physics. This means that…….

Okay, the word fundamental which has been underlined there……anyone who knows the meaning of this word?.....Yes….What does it mean to you…..(Silence)…But I thought your hand was up…..(Learner shaking head)….you couldn't tell what it means?....completely? ….you went blank….?.....you we not blank, there was something you were thinking then, I want to hear that……(silence) ….Okay…. Let's hear from this side

L11:It has something to do with importance…..

I: Okay…..about importance…… When did you first meet this word?

L3: Chemistry…

L12: Natural Science….

I: Okay, let's hear from the guy who says in Natural Science…And other people here (pointing at some learners)

L12: I saw it in Natural Science but I do not know its meaning…

I:…..Okay, but now when you see such a word you do not understand, you did not ask…..did your teachers explain it?

All: No!

I: Alright, do you want to say something? You can give an example…..

L12: ……(Inaudible)…..water….

I: Water is fundamental?.....Okay, the correct answer there was "The most important laws of Physics"……And then the other one that you had a problem with…..not a problem as such but it was interesting for me was question number 6…….which reads as:

The teacher felt that the learner's interpretation of the experiment was <u>valid</u>. This means that the teacher felt that ……..

So the word here is valid. What does that word mean?

L13: It means brief

I: Okay, brief for you…and…. for you?

L14: It means correct..

I: …Correct for you….?

L15: Worthless…..

I: Okay…..for you it means worthless

L16: Not correct

I: Hey, we are having different answers now….!

L3: It means sound….

I: …..Class she says that it means sound……(Learners laughing)….Ehhhh?..Do you agree with her?

All: No…Yes…Noo!

I: Don't you think she is 'crazy'? Doesn't sound go like "Vruuuu….!"….(Learners laughing)..

L3: No, not that sound….

I: But when I am talking like this, I am producing sound, isn't it……And then she says the answer…is it sensible to you?.....They don't agree with you lady….

L3: Not that sound, ngisho ukuthi uyayi andastenda, hayi ukuthi uyayizwa..(I mean that you understand, not that you hear it).

I: uyizwa kanjani? Enqondweni zakho iyakhuluma? (How do you understand it? Does it talk in your head? (Learners laughing)

L3: Ngithi lento iya andastendeka…hayi ukuthi uyayizwa (I'm saying that this is understandable not that you are hearing it….

I: …….Okay….now we understand it…….Okay, what do you see now, some words are funny, Neh? At one time they mean one thing and another time another thing. In fact, the correct answer there is "sound"…..Is it not interesting?...

L17: Is that correct?

I: Yes she is correct! Class she still does not want to accept that she is correct….Heh! Okay, let's go to question number 5. We are left with just two questions to analyse and then I'm done. Question number 5:

The triple beam balance is a very <u>sensitive</u> instrument. This means that the instrument……..

When did you first meet this word?..... Or do you know the meaning of this word? What does it mean for you? I didn't say give me the answer there….I said what does the word sensitive mean to you?

L18: It means fragile

I: It means fragile? Do you agree with him?

L7: What is the meaning of fragile

I: Look, someone is asking for the meaning of fragile…What is fragile to you? Can you explain for us please?

L18: Something that needs to be well protected…

I:……Something that needs to be well protected….Someone else….Have you met this word before…..or used it before?

All: Yes!

I: Alright, where?

L3/L7: In Physics…

I: right, in Physics?

All: English!!

I: English…? Not in Physical Science? Hawu! (Gosh!). You have not met this word in physical science….I'm surprised! Alright, when you first met that word, teachers explained it?..... (Silence)…… Or that you learnt it by yourselves?

All: ……By ourselves…

Interviewer: Alright, the answer to that question was……."that it can be used to measure very small things". So has it got to do with being fragile…..or protecting it….? No!! Strange, isn't it?

All: …..Yah, strange…..

I: ….And then our second from last…….question number 3:

The electrician fits the water heater in the most efficient position. This means that…….

The word is efficient. Do you know the meaning of this word?.....When you say something is efficient, what do you mean?

L17: It means well fitted

I: To you it means well fitted? What about other people? If you say something is efficient, what do you mean?

L3: It means adequate

I:….adequate?...okay, give me another term which is not adequate?.....(Prolonged silence)…someone to help her…..(Further silence)…..So where have you met this word before.

L17: Efficient sound…….

I:……Alright I have two cell phones here, I have a Nokia and a Blackberry, which one (has) efficient sound?

L17: Nokia…..

I: …..Nokia, what does this mean then? Does this not mean better or not better?.....Okay, the actual answer for that question was: "….the best position….".The last question is number 1….some people got it and some did not get it…….not because they were wrong…but because they had other ideas or they were thinking of something else….Ehhh:

The sample was weight at midday on ten consecutive days. This means……..

What does the word consecutive mean? It means what…? Your hand is moving up and down…..

L4: …one after the other….

I: Other people, what does consecutive mean?

L3: continuous….

I: Alright, in this situation now, what does this word mean?

L3…..everyday…..

I: Do you agree with her?

All: Yes!

I: But you said continuous before….Mhhh?...Alright you are correct…what do you realise about words, they have different meanings in Physical Science, Life Science and everyday meaning……

L17: I still want us to discuss about the word sound…….

I: ……Let her chazela (explain) for you in Zulu……(arguments and counter-explanations from different learners in Zulu)……Alright, Alright…..what we not is that words change meaning from context to context……

Thank you very much for being cooperative. May God bless you

2. LEARNER INTERVIEW (SCHOOL Q)

KEY: 'I' means "Interviewer"; 'All' means "All or Most of the learner interviewees in the group at once"; 'L' means "Learner interviewee" numbered from 1 upwards e.g. L1 or L2

I: Alright……good morning once more

All: Morning sir

I: You answered the questions I gave you and I have marked them…….analysed them and I saw some interesting answers which I want to discuss with you …*BEEPING SOUND…….(INTERRUPTION FROM THE SCHOOL'S INTERCOM SYSTEM ANNOUNCEMENTS)*…….remember……I am actually recording what we are talking about……. *(FURTHER INTERCOM ANNOUNCEMENTS)*…….Alright….so when you are answering try to rise up your voices because I am trying to record your voices using my cell phones. Err……. On question number 5, the question reads as follows…..err: "…the beam balance was very *sensitive*……..the balance was very sensitive"…and…. Most of you……many of you chose a certain (interesting) meaning of this word…. *(INTERRUPTIONS FROM LEARNERS THAT ARE JUST WALKING IN FROM OUTSIDE AND INTERVIEWER PAUSES*)…… I will start once more. I said that I gave you a questionnaire which you answered, isn't so? Then I marked the (answers to that questionnaire)….and I analysed your answers. So I will try to interview you on those answers you produced. So when you are answering questions I ask you now, please raise up your voices because I am trying to capture your voices using my cell phones…Okay? Question number 5 talks about the word *sensitive*…….Err….Is this word actually familiar to you? Have you used it before?

All: Yes!

I: What does it mean actually….?

All: (*mumbling inaudibly*)

L1: *Precious*

I: It means *precious*?

L1: Yes!

I: Where do you normally use this word in everyday life? Eh?

L2: Some people use it in…… (*Inaudible*)……something about precious

I: So it means *precious*? What about you? (*Interviewer referring to another learner*)….Eh what does it mean to you?

L2: It's about emotions, actually……(*inaudible*)

I: Uhhmmm?..... some of you chose the meaning " getting spoilt easily" in their answers. Do you agree with them? Ehhh?

All: ….Yes! No! …… (*Mixed opposing answers*)

I: But why say it means "getting spoilt easily"? Is it similar?

L1:It is…..! (Learner reaffirming her answer)

I: Is it almost the same? And, in Physical science, have you encountered this word?

All: Yes!

I: Where in Physical science?

L3: When you talk about how to measure something…. You know where it says…….to measure with a scale……

I: Uhmm! And other people, where do you encounter this word? …..oh, you still talking (*referring to L3)* are you referring to a scale? Or you are just reading the answer from the paper?

L3: No! It's something that I..I…I know! Something I have encountered.

I: Uhhmm……! And now question number 6……the question says (*Reading from question paper*):

The teacher felt that the learners' interpretation of experiment was valid.

You know this word *valid*……..you have met it before…? Have you used it before…sir (*Pointing at learner L4)*

L4: Yes

I: Where?

L4: In writing a scientific experiment…..you say it is valid.

I: Eeehm! What about other people? Where have you used this word before?

L5: In a cell phone…..when you put a pin number it says valid and when it is wrong it says invalid

I: Ehmmm. It says invalid

All: Yes….! (*Many learners mumbling with interest and their teacher walks in and sits at the back of the class)*

I: Ahhaa……! Let's look at another word……..question number 15……..question 16 says that:

The experiment was designed to prove that the brass rod would *contract* when cooled.

Okay, this word "*contract"* ……what is the meaning of this word….again?

All: Yes!

I: What does it mean?

L6: Attracting, shaping……. (*Signalling with his hands to show squeezing effect*)

I: Ehhh……? Let's say you have something like this and it is cooled……what does it do?

L5: It means solidifying or become smaller

I: It means solidifying, becoming smaller……ehhee….what about in the science context, in a classroom like this, what will be the meaning of this word? Will it be different?

All: Nooo! Yes!

I: So what does this word mean in science? Is its meaning the same in everyday life and in class?

All: ….(*inaudible mumbles*)……

I: Okay, what about your teachers, have they ever used this word before with you?

All: Yes!

I: Where?

L7: In life Science they talk about it…….

I: And in Physical Science?

L8: ……..When you fill up a balloon with air, and you rub it to become smaller……

I: ……..But it doesn't show that it becomes smaller when you rub it, does it?

L1: ….It does….

I: Okay…..Let's look at question number 20…….question number 20 reads as follows:

By *convention*, electric current flows from the positive terminal to the negative terminal of a battery

Have ever met this word before?

All: Yes

I: Where……yes, sir….(*pointing to one learner*)…..you are quiet, sir, why?

L9: …..about conventional current flow…

I: …..conventional current……okay

L10: I've met this word before in social sciences about special conventions meaning a norm which is accepted by certain people or a norm which is common in society.

I: Interesting… and in Physical Science…?

L10: It does have the same meaning to the sciences…..

I: What about everyday life?

L11: It means an agreement…

I: Oh, an agreement?

L12: Something that is agreed upon, everyone accepts it.

I: And your teacher, did he explain this word…….let's talk about the Physical science meaning…..

L13: …….when we talked about the conventional flow of current….

I: So did he explain the meaning of the word?

L14: Ya…convention… it means changing

I: It means changing….? So that's how he explained it?

L14: Ya!

All: …(*Learners glancing at their teacher seated behind them and smiling)….*

I: Don't look at him! (*Learners laugh and the teacher walks out of the classroom*)

L14: That is actually my understanding of the word!

I: No problem, I just wanted to know whether the teacher explains the words or not so that I can see where to pick up the meaning of the word. Okay, let's look at another interesting one, question number 23 which says:

When the sample is heated for too long, it disintegrates.

Have you met this word before?

All: Yes! No! Never!

I: Okay, Never or Yes? Those who say they have used it before?

L15: ……in Life science….

I: What were you talking about in Life science?

L15: The uterus wall disintegrating…..

I: Ohhh, the uterus wall disintegrating! What about in Physics, you seem to be running away from Physics. You mention Social Science……So what does this word mean in Physics for those who say they have met this word before.

L15: It means to breakdown

I: …To breakdown. Many of you said it means to 'disappear'. Did your teacher explain it?

L10:I personally, I was never taught this word by any science teacher……it's something I relate to *integrate*….which means to bring together…..so the opposite would be to *disintegrate*…..and in Physical science I remember in the reaction of magnesium the teacher said that it was disintegrating in the acid

I: So….it does disappear…?

L10: …Ehhh, it does disappear, eventually…

I: So it disappears?

L10: Yes…

I: Those were the FIVE words that I wanted us to discuss. Thank you very much ladies and gentlemen. I am done!

All: ….. (*Learners clap hands cautiously*)

3. LEARNER INTERVIEW (SCHOOL M)

KEY: 'I' means "Interviewer"; 'All' means "All or Most of the learner interviewees in the group at once"; 'L' means "Learner interviewee" numbered from 1 upwards e.g. L1 or L2

I: Alright……good afternoon boys and girls!

All: Morning sir!

I: Last time you wrote an exercise…..sorry, say a little test or survey where I asked you questions about words that you meet or use outside the classroom and then when you come into the classroom of Physics, you find such words in the context of Physics. And then they have a particular meaning. And when you answered those questions I gave you and I have marked them…….analysed them and I have a few selected ones to discuss. For example, lest start with number 3……So question number 3 says:

The electrician fits the heater in the most *efficient* position. This means that…….

Do you understand the meaning of the word *efficient*?

L1: means *best*….

I: …It means best for you?...okay….why do you say it means best? Why do say that?

L1: To me it means best….

I: ……(Learners laughing) …..You do not know why you say it means best?

L1: It's all about the best idea…

I: Okay…..what about the others, what does it mean to you?

All: It means best…..

I: ….*Best* for everyone, okay…….where have you met or used this word before? Is it in class or outside class?

All: In class!!!.....Outside…..(Mixed answers)…

I: Alright, for those who say outside the class, where do you normally use it? Give us an example…..(Silence)…..Heh! Heh! It's difficult to say, Ehhh?

L2: When people are talking….When they are discussing……?

I: Okay, what do they say?

L3: Sir, I heard it in Life Science……

I: Okay, in Life Science……?

L3: …Yes when Mr. #### explains about……

I: …Oh, you have a teacher called Mr. #### in Life Science?

L3: …..Yes, he says that the Alvioli walls are made for efficient gaseous exchange or diffusion….

I: Okay, what about in Physical Science?...Have you ever met this word in Physical science?

All: Yes...

I: Where……which topic?.....(Silence)……Which topic guys…….Alright, you don't remember. Since you heard this word in Physical science, did your teacher explain its meaning? Oh they just mention it and pass?

All: ….They just pass it….

I: Is it so? Okay, let's go to another one……..the other one of interest to me was question number 4……which say:

Metals produce a *characteristic* sound when they are struck. This means……

Do you know the meaning of the word characteristic, guys?

All: Yes!

I: Alright, you think you know that? Let's be free…let's start debating….what's the meaning of characteristic?

L4: I do not know the meaning now……

I: Alright, give us an example…….(silence)…..So you do not know the meaning of characteristic? Ehhh?

L4: I think it means something unique, I have my own character and she has her own…

I: okay, *unique*…..what about you?

L5: It means differentiation…

I: What do you mean by differentiation?

L5: ….Like…..let's compare *BLACKBERRY* and *NOKIA*

I: Oh, you mean phones? So how does characteristic come in there?

L3: The quality of their pictures….

I: So those are their characteristics…?

L3: Yes….

I:So when you are using that word *characteristic,* you are trying to….*differentiate?*

All: Yah!

L6: Classify…

I: Or classify for you?...

L6: Yes..

I: Alright……Ehhh, in Physical Science, have you ever met this word…..Characteristic?

All: Yes!

I: Okay, which topic?

L7: In Chemistry…..Ehhh, when you are talking about the properties …..

I: Oh, properties of substances…so you have used this word before in Physical science…..so when you first encountered the word, did your teacher explain its meaning?

L8: Yes…..

I: How did he explain it?

L8: He said metals are different from non-metals due to their characteristics.

I: Okay…very good! Where else did you use this word besides Chemistry of Physical Science?

L3: In Life Science….

I: You love Life Science, isn't it?

L3: Yes, I love Life Science because it's clearer…..

I: ….than Physical science…..okay. Let's go to question number 5……:

The beam balance is a very *sensitive* instrument. This means that…….

Do you know the meaning of the word *sensitive*?

All: YES!!!!

I: Ohhh! The Yes is everywhere! Okay what is the meaning of *sensitive*? (Commotion, learners laughing showing that they are getting relaxed). Alright…….yes….Quite guys so that I can hear this gentleman.

L9: Something fragile, something that can easily break……

I:……..fragile…….easily break……..Who else can give me a different term or you are going with him all of you?

All: Yes

I: ……okay, something fragile, something that can easily break

I: When do you use this word, at home?.....

L9: At home, with people

I:What kind of people are fragile?....(Commotion, learners talking to each other with interest)

L9: Albinos…!

I: Albinos are fragile?.....(INTERRUPTION FROM AN INTERCOM ANNOUNCEMENT)….

L3: No, very sensitive….

I: So when we say that the instrument is *sensitive*, is it *fragile*?

L9: Yes……it breaks easily

I: So this means that the instrument is fragile? What about in other areas, have you ever used this word in Physical Science?

L10: Yes …

I: Where…? Give me an example….

L11: When you are doing practical experiments, when you are using the tubes, they are fragile…

I: Alright….did the teacher explain the meaning of this word when you encountered it in Physical science?

All: Yes…

I: What did he say was its meaning?....

L12: He said handle the beaker with care because it is fragile….

I: Okay, let's go to another word of interest to me……Question number 6:

The teacher felt that the learner's interpretation of the experiment was *valid*. This means that……..

What is the meaning of the word *valid*?

L12: It means *brief*

I: For you it means *brief*. And then, for you what does it mean? Do you all go for its meaning as "*brief"*?

All: Yes!

I: When did you first meet this word before?

L12: In English…

I: Give me a sentence using this word…….(Mumblings)……And in Physical Science….

L13: When something is *invalid* it is incorrect and when it is valid, it is correct.

I: When you first encountered this word in Physical Science, did your teacher explain it?

L13: No, he didn't explain…

I: So he assumed that you know?

L13: Yes…

I: Is it so? Another word that I chose is of question number 9:

Your science teacher said that she was going to *evacuate* the flask. This means that…….

Do you know the meaning of the word evacuate?

All: Yes!

I: What does it mean?.... (Noise and commotion- evidence of boredom and disinterest in the exercise)……Let's be together, guys. Let's answer the questions….Were you just guessing your answers?....

L19: to remove….

L17: to empty…

I: …But many of you did not give me those answers…..Can I have those who have not given any answers. Chief, have you ever met this word in Physical Science?

L20:In school, when there is a fire, learners must be evacuated……

I: …So which means that when you are evacuating, you are removing. I am left with just two words……lets go to number 12:

The teacher referred to the motion of the pollen grains as *random*. This means that…….

What does the word random mean?.....It means what?

L19: Something common

L21:Something forming a pattern..

L20: Something usual

I: Have you met this word before….sir?

L22: When you refer to a girl as random?

I: What do you mean by that?

L 22: When a girl is "usual" and moves anywhere, she is random

L16: In Physical Science, when we studied of matters and materials about the motion of the particles of gases….they move at random…

I: One last one guys…let's conclude this nicely. Let's not jump out without concluding…. Let's go to number 14:

Some students were studying the ***fundamental*** laws of physics, this means that…….

Can we have this side of the class? What does the word fundamental mean to you? ….Do you know it?

L3: It's a source or base of something…

L6: The core of physics…

L17: The main thing…

I: When did you first use this word in Physics…..Where in Physical science?

L17: When we studied, Boyles Law, Charles Law and the rates of reaction, Redox.

I: Did the teacher explain the word to you? Thank you very much, have nice day

4. LEARNER INTERVIEW (SCHOOL N)

KEY: 'I' means "Interviewer"; 'All' means "All or Most of the learner interviewees in the group at once"; 'L' means "Learner interviewee" numbered from 1 upwards e.g. L1 or L2

I: ….(Recording initiated when the interview had already started)…..actually why you chose to use particular answers to the questions. That's what we want to talk about, alright?.....Errr....We start by looking at question number 2…. we are selecting 6 words only, not everything….only 6 words….lets go to question number 2 which reads as follows:

The thermos flask is a useful *device* for keeping hot liquids. This means it is…….

Okay, guys….have you met the word *device* before? Have you used the word before?

L1: Yes…

I: Where?.....

L1: At home…..

I: So at home you have used that word? So, what's the meaning of that word?

L2: It's like an appliance.

I: …..appliance….and to you, what is a device (Pointing at another learner)

L3: Something electronical…

I: ….Electronic like what, for example?

L3: Like a phone….

I: Okay, and your teachers, have they ever used this word with you before?

All: Yes…

I: In which topic?.....Ehhh?.....In English or in Physics?

L4: Yah, even in English….

I: Where in particular? Can you give us exactly where you used this word before….Do you remember or you do not remember?.....(Silence)…..Once that word was mentioned by teachers, did they explain it?

All: No!

I: ..They never explained…..Okay let's just go to another word……question number 4 which reads as:

Metals produce a *characteristic* sound when they are struck. This means that…….

L4: Strong sound….

I: Wait, do you actually know the meaning of that word, *characteristic*

L5: It depends

I: This guy says it depends….it depends on what?

L5: Depends on what you are talking about

I:…Let's assume we are talking about physical science what does it mean?

L6: It's about properties…..of objects….of things.

I: Okay, what about you, sir?

L4: How to identify something

I:So characteristic means how to identify something…..where did you first meet this word…okay, how did you use it in physics?

L5: Like in a character of something…..

I: Okay, so characteristic comes from character, Neh? Anything else?

L6: It's about *being similar*…

I: So Characteristics is about being similar?

L7: Characteristic is a graph….

I: Okay, it's a graph in your other subject called Electrical, Neh? Okay, fine. And, when you first used this word, did your teacher explain its meaning? (Laughing)

All: Yes

I: Okay, let's go to question number 5 which says that:

The beam balance is a very *sensitive* instrument. This means that…….

……(Several learners shouting from the background: "Gets spoilt very easily")…… Do you actually know the meaning of this word? ……..What's the meaning of this word, guys?

L6: Something that you cannot use in a rough way…it gets spoilt….or if it's a device, it gets destroyed.

I: So do you think that if you are using a triple beam balance, it gets destroyed ….is it so?

L6: Eh, if you put it in a stationary position, it can fall over.

I: okay, what about other people? What do you think about this one? Do you all agree about it? Okay….and have you ever met this word before in Physical Science?

All: No!!

I: Someone said "yes". So, is this the first time that you see its use in Physics?

All: Yes!

I: Okay…Fine. Let's go to question number 6…….It says:

The teacher felt that the learner's interpretation of the experiment was *valid*. This means that……

What is the meaning of the word *valid*…....(Disorderly behaviour of the group starts to show as learner shout answers carelessly)…..

L7 : Brief

I: You say it means brief…where did you see such a meaning?...

L7: In a phone, when it says invalid……

I: So that means brief?.....(learners laughing and shouting rudely)..

All: *Kuyafana!!* (What-ever!)

I: I am trying to interpret what you are telling me sir…….it's what?

L7: It is the opposite of valid…

I: What does it mean, then?

L8: It means brief…

I: Okay….Let's have the guy at the corner there…

L9: Sir, it's correct, but it means something, so its brief….

L10: It means sound!

I: He says the meaning of *valid* is *sound*….do you believe him?

All: Nooo! Yes!..... How can sound be…….(inaudible)

I: Okay, guys, if I can tell you, the correct meaning of *valid* here is *sound* will you believe it? That is the correct answer!

All: Aaaah! (Gesture of surprise and disbelief)

I: That is the meaning of valid in this case….but not always. Let's look at question number 8:

The results of three experiments were *consistent*. This means that the results were

What's your answer to this question?

L6: It means the same…

I: What is the meaning of this word……

L10: It means adequate..

I: Have you ever met this word before in physical science?

All: Nooo!

I: This is the first time you see it? What about in other subject?.....(Commotion and disorderly behaviour…)

L6: Sir, they are lying, it is there in Physics….

I: Okay, give us an example….help us….

L6: I will check in the book (opening the Physical Science text book)…..

I: Okay, thank you very much…You say your teacher has never mentioned this word before….okay, you have found it, give us an example….(Commotion and noise)…. Guys, can we be together, please! Can we be together…..! (Further disorder)……..Excuse me, guys…you know what, if everyone talks at the same time, then there is no order…Can we have order because we want to advance and finish up, alright?.....Please! Chaos is not good at all, there is no progress in chaos….(peace and quiet restored). The other question that I want us to look at is question number 12…….which says:

The teacher referred to the motion of the pollen grains suspended in water as *random*. This means that the motion…….

What does random mean to you?

L11: *Nomayini*, sir (What-ever, sir). ……(Other learners laughing)

I: What about you?

L12: ….means no order

L13:….*Jwayelekile, nomakanjani* (usual…anyhow)

L12: No order at all…

I: ……okay, what do you mean by no order at all, okay in everyday life?

L12: If a taxi moves anyhow and collides with other cars, it means it happens randomly…

L6: Sir, like you…..you walked in randomly whilst we were learning.

I:……Okay……(Laughing)….I see …I walked in randomly and then I affected your learning.

All: Yes!!!

I: Yes, you…

L12: You can also say I randomly chose this car…

I: What do you mean by that…?

L12: …I do not care how I did it, I just picked it anyhow…

I: Okay, and in Physical science, have you met this word before. Is it the first time you hear about this word being use in the Physics situation?

All: …..(rudely, again)…..Nooooo!..They are lying…

L14: No it's not the first time…..(Disorderly noise)

I: ..Let's be together again this side, please…

L13: In grade 10 when plotting a graph, when the points are scattered, they are random….

I:….Okay….and did your teacher explain that?

All: Noooo!!!

I: Okay, they think you know the meaning? And will you be knowing?

All: Noo!.....Sometimes, yes…..

I: Let's continue….In fact the answer there is " there is no order at all"…..Let's go to question number 13. It was of interest to me…..it says:

The speed limit for the vehicle was 40km/h. This means that the vehicle……..

(Noise and commotion again)……You are no longer speaking as a class….you are now speaking to yourselves. Can we have order, please. I want to hear you, sir…we want to hear what you are thinking…..Yes….whether you speak in Zulu, it doesn't matter…

L15: *Esitaradeni*, sir you are allowed *ukuthi udlule kancane*. (In the road, sir, you are allowed to exceed the limit a little bit)……(Learners shout chaotically)…

I: You are saying that you are allowed to exceed the limit, Ehh? So what does this word limit mean to you?.....You are becoming chaotic again!.....okay, when did you first meet this word…

L6: In Mechanical, the speed limit means maximum.

L7: Also in Physical science when we talk about limiting reagent….

I: Okay, did the teachers explain the meaning of the word?

L7: Yes…

I: Okay, thank you. Another one of interest was question number 15. I just chose the words that are of interest (in the research), meaning that there were a variety of answers which were not correct. So I want to see how you came to those answers. Question number 15 says:

The experiment was to prove that the brass rod would *contract* when cooled. This means that…

L13: Sir, change colour

I: This guy says the underlined word means to change colour. What's the meaning of this word, then?

L13: It would be darker or brighter later..

I: Okay,……..the girls haven't said anything today…..(Bell rings to signal the end of the period with this group)

L14:Changes colour

I: What about the guy at the back?.....….? Please answer quickly because the time is up, we have to go

L6: To become larger, sir

I:Have you ever used this word in Physical Science?

L4: No!

I: Alright, the correct answer was: "to become shorter". …….and the last one, 1 minute only, Question 25, that's the last one:

The student marked the *adjacent* crests of a wave. This means that…….

What's the meaning of this word…..Ah, first girl to answer today..Ahaa?

L16: It's a,.....sir!....

I: So, what's the meaning of the underlined word?

L12: Next to….

I: Have you ever met this word before in Physical Science?

All: Yes! No!

I: Someone says YES and someone says NO……Alright, you over there. One person at a time.....Please!

L12: …..In calculating angles…….

I: …..Where? Give us an example…You have forgotten? And did your teacher explain the meaning of that word?

All: Noooooo! (Making a lot of noise and standing up to leave)

I: Alright, thank you very much for this interview. Have a nice day…Bye, Bye

5. LEARNER INTERVIEW (SCHOOL L)

KEY: 'I' means "Interviewer"; 'All' means "All or Most of the learner interviewees in the group at once"; 'L' means "Learner interviewee" numbered from 1 upwards e.g. L1 or L2

I: Good afternoon once again learners……We will analyse answers that you gave for the questionnaire…..you are going to tell me why you chose the answers that you chose… okay. Let's start by looking at question number 5 which reads as follows :.....(reading)

The beam balance is a very *sensitive* instrument. This means that it.....

Okay.....Do you know the meaning of the word *sensitive*? Did you use it before...?

L1: Yes, is ....it is like fragile....like breaking easily.....

I: Okay, what about the other people, what does it mean.....(prolonged silence)…..You are a shy group, isn't it?

All: ....(laughing).....Nooo!

L2: Well for me I …..(*inaudible*)……something that can spoil easily..

L1:....Yes..it's the same as fragile.....*kuyafana* (it is the same)

I: So something "fragile" can get "spoilt easily".....

L1 Yes, sir....

I: Okay...Where did you first see this word in Physical science.....

L3: Sir, in life, when someone is sensitive...she easily cries or gets upset easily....(Laughing)

I: Okay....now, where have you used this once in the classroom?

L4: In....eh....this topic of electricity.....the ammeter is sensitive

I: So, what does that imply if it is sensitive?

L4: (barely audible).....get damaged if you make wrong connections...

I: Did your teacher explain the meaning of this word when you saw it

All: .....(mumbling and giggling).....

I: Okay, let's go to another word....but please participate so that I may know what you are thinking...Let's go to question number 6 which says: (Reading)

The teacher felt that the learners' interpretation of experiment was *valid*. This means the

teacher felt it was.....

Interviewer: Oh you think you got it correct…we also want those who think they got it incorrect as well…….what is your reasoning behind your choice?

L5: It means "brief"....

I:You think that it is the correct answer, but is that the actual meaning of the word *valid*? How did you come to associate that meaning to this word?

L6: Something valid is like a short correct answer....a brief answer....like the pin of a credit card or cell phone. If...sir ...it is not correct...it is *invalid*.....

All:.....Yah!.....Yes....

L7: All pin codes are three or four numbers or letters.....

I: Did you use this word before in the science class room?

L8: The Physics teacher Mr##### likes to say that your units are *invalid* when they are wrong...

I: Okay...So did he explain to you what he meant when using this word.....(learners laugh)... what is wrong? Just answer me, please!

L9: But....sir....there is no need to explain such a word...it..

L8:....it is obvious to everyone.....(laughing)....

I: Interesting.....Let's go to another question.....question 15 which reads as follows:

The experiment was designed to prove that the brass rod would <u>*contract*</u> as the temperature fell. This means the rod would

What is the meaning of the word "*contract*" to you?

L7: I think it means to move in or come together....

I: Do we agree with her?.....Ehhhh?.....(Silence).....

L10: Sir,...can I talk about Life science...?

I: ...Yes.....go ahead..

L10: ...when we breathe in the chest contracts....and when we breathe out, the chest expand....so "contract" means to move inwards or...to...to bring together...

I: Okay.....what...what about in Physical science, what does this word mean?

L5: It should be the same, may be it means.....ehhh...to come together and be firm...be hard...sir, like the chest...

I: When you first met this word, did the teacher explain it to you...?

L10: Yes, sir.....he explained what contraction was and ...with an experiment....demonstrating to breath it and out....and ....the changing volume of the chest..

I: Yo!! Now we are in a Life Science lesson...(Learners laugh)...

All.....Life science is *lekker* (okay).....

I:.....okay....okay. So that is why many of you chose B ....."to become harder"... as your answer..? .... If I can tell you that the answer I expected was C...meaning to become smaller, would you believe me?

All: Ahhh! Sir.....*ngeke!* (Never)...

L7: I think that answer also works....there....coming together squashing ...makes small...(Signalling with hands)....

I: Okay, let's leave it there.....let's leave it there, I get your reasoning as well.....Let's look at question 20 which reads as follows:

By <u>*convention*</u>, electric current flows from the positive terminal to the negative terminal of a battery. This means that this direction of flow

What does the word *convention* mean to you?

L5: Sir, ...it means something well accepted by many people.....like rules of a game.....

L8: Noo! .....it is not...it means something about Physics....like a formula of Ohms Law....V = I x R that can be used to calculate current flowing in .....a ....in a ...where the battery is connected....

I: What about others, do you agree with him?

L7: No, sir.....when you are connecting a...circuit, you show where the current is moving with an arrow....from positive to negative and then you calculate the current using the equation....using the formula....

L5: ...But....it does not mean...that...it is an agreement....

I: Where did you first use this word?.....in which topic and subject...?

L8: ...(shouting)....In Electric circuits....Physics with Mr #####.....

I: Okay...Okay! Did your teacher explain the meaning of the word...?

L7: No..... But...He told us that there conventional direction..... and this is opposite to flow of electrons.....

All: Yesss!

I: so he did not explain the word meaning, did he?

L8: Nooo!

I: The answer I expected was A: ...something accepted as an agreed practice...

L5:..Yess! I told you....

I: ...Alright, let's go to the last question.....question number 23 which says:

When the sample is heated for too long, it ***disintegrates***. This means that it

What is the meaning of the word "disintegrate" to you

L8: I did not know this word and I guessed my answer...

L7: Me too!.....(Laughing)...

L5: Sir, it means to break up .....

I: Do you agree that it means to break up, class?.....(prolonged silence)...

Have you met this word before in class?.....(further silence).....Okay...does it mean that this is the first time you see this word?

All: Yes.....!

L5: I met it when I was reading about the womb of a woman during menstruation.....its lining disintegrates or breakdown.....in Life Science...

L8: Okay....Yes...in Life Science, not in Physics.....Yah..!

I: So, Did your teacher explain the meaning of this word..?

L5: I do not remember but I checked my dictionary for the meaning when I was studying for the cycle test....

I: Okay, my expected answer was" to break up into smaller pieces".....(Some learners shake hands with L5)...Thank you very much ladies and gentlemen....You are very brilliant..

All: Thank you sir.....

APPENDIX D:

TEACHER INTERVIEW TRANSCRIPTS

1. TEACHER INTERVIEW (SCHOOL D)

Key: *"T" represents the Teacher interviewee; and "I" stands for the Interviewer*

I: Yah……, good afternoon, sir!

T: Afternoon…..

I: Okay……Last time I had a questionnaire which I gave to your learners then they answered the questionnaire about use of everyday words in Physical Science and I interviewed them…Based on that interview and questionnaire, that's what I want to talk about with you today……

T: Okay….

I: Alright, in the first place, I just want to know where you get the majority of your learners…….. Where do you get them from….suburbs or……?

T: Area? You mean like rural or surrounding?…..Eh…it's like there are few squatter camps here like Makausi, Ramaphosa, and Denver, and also from the Hostels. Also, we do have learners coming from other countries like Zimbabwe and Swaziland. This is because we originally adopted the school from a…..Eh… we inherited this school from Ekukhanyeni (community school, an NGO welfare centre) which was a private school.

I: …Now, are the learners paying any school fees?

T: No, they do not pay any school fees……. (Because they are from very poor backgrounds)

I: Do you provide food for them?

T: Yes, we do provide food……we do feeding scheme that is why we have an hour long break on a daily basis, there are ….(Inaudible)…..who are cooking for them every day…

I: Okay, and, where do they usually do sports (since there are no sports fields around here)?

T: Okay, in the middle of the year we organise grounds like Rhodes Park……..Eh……it's a park……then we hire the grounds….. Then we do our sports there. If there are schools that need to be challenged, then we actually make sure we visit them…..and then we do that…..

I: ….And your buildings, are they going to be temporary structures like these forever?

T: Basically, we are promised (by the government) may be by the end of three years to four years then they will build a school for us because the buildings you see are temporary structures that last for 3 years

I: …And the government pays for all that….what about the day to day expenses for running the school, who pays for that?

T: We are a Section 20 (state funded) school….so all our budget is controlled by the government, where they give us the term money to run the school…….all is dependent on the government, unless if we were section 21, then we could have controlled our budget by (charging school fees)……but we are not

I: Now we come to the words that actually gave your learners problems, we want to talk about three or so of them….if you look at question number 5……(giving the teacher a questionnaire paper and reading the question aloud..)…When I asked them in the interview, they said the word sensitive means getting spoilt very easily and I also asked them whether they met this word before in Physical science, some of them said No and some said Yes and they met it in Life Science and then I also said do teachers normally explain them to you……okay, in your case, do you normally explain such words to your learners?

T: Look……Eh…we are a school facing many challenges in Physical Science, where we do not have a laboratory, so we find it very hard when we want to do practical experiments and to explain. We do not have the apparatus…..like when we talk about beam balances, it's a challenge to them since they do not know what you are talking about…..

I: How then do you go around it yourself?

T: Well, what we do….like this year, we had to call Sci-Bono (Science Discovery Centre) to come and do prescribed practical experiments in order to assist…..

I: So it is a challenge to explain to them certain words…?

T: Yes it is a very big challenge, and even if you explain theoretically…….I try sometimes explain using the …digital (computer simulations) using my projector on a screen….but it is not like a hands on way of learning as I explain..

I: Now, let me ask you something more personal, you look like you are an experienced teacher……..how many years of teaching experience do you have……maybe before you came here, you were teaching somewhere else, isn't it?

T: 16 years…Yah, it was a better (equipped) school…but you know challenges in South African schools are wide spread, where some schools are so old and the laboratories are not functional and that is the general challenge we face as Science teachers, or you get to a functional school but you struggle to get a functional laboratory

I: Let's go back to my research, which is about the use of everyday words in the Physics context, you said your learners come from squatter camps and other poor backgrounds, do you think this is a challenge in terms of expressing themselves and understanding English (as the medium of instruction)…….

T: Yes of course, that is why we are trying to introduce other languages like Isizulu to help learners when we explain……..although our language policy says that learners must strictly communicate in English here at school….

I: You mean like code switching….as you explain, do you allow them to use other languages?

T: Yah, look….the role of language……it is something that is being discussed…..hopefully that the role of language helps in science…….though the challenge about these words in Physical Science is that you cannot use African (indigenous) languages to explain certain terms because they lose meaning but we do try by all means to use the language that they can understand as you explain for them….

I: Are you aware that some of these words can take some contextual meaning, like this word *sensitive*, it can have a meaning which is particular in Physical Science but when it is used outside the science classroom, it changes to something else…are you are of that?

T: Yah,…..that is true……

I: Okay, that is all from my side (since we have exhausted the time allocated)…(Other staff members walk in to the staff room forcing us to abandon the interview……)

(What follows is general talk as I prepare to leave…)

T: If I may ask, what are you finding in terms of teaching using African languages in schools…..?

I: I am afraid, that is not in line with what I am researching for now or in my previous research. This one is about the use of everyday words and how they change their meaning depending on contexts…I want to find out whether the teachers are away of that or they continue teaching without explaining the meaning assuming learners know it, yet learners pick other meanings from outside the Physics classroom and other subjects (phone rings)……do learners actually have problems with these everyday words…do they actually understand when these words assume contextual meaning…… (Phone rings again). Thank you very much sir….. (Walking out of the staff room)

2. TEACHER INTERVIEW (SCHOOL Q)

Key: *"T" represents the Teacher interviewee; and "I" stands for the Interviewer*

I: Alright……, good evening, sir!

T: Good evening Mr Ncube

I: How are you?

T: I am okay, and yourself?

I: Fine….okay, I am making a follow up of the …..Eh….the time you gave me with your learners… to give them a questionnaire concerning the use of everyday words in Physics. Remember that they answered the questionnaire and I interviewed them…….so it's just a follow up on the answers that they gave me…..

T: Okay….

I: Alright, I would like you to give me a brief background of your school…..Eh……like what kind of school is this one, for example, is it a former Model C school or what……..

T: I believe this is a former Model C School, eh, but normally most of our learners come from Soweto, even though we also enrol learners from the surrounding areas of Bez Valley, Kensington and some from Yeoville……it's actually a mixture……..they don't actually come from one fixed area…..

I: Is it a fee paying school?

T: Yah, it is….Eh…., this year we actually celebrated our 75 years of existence…yah…so it's quite an old school….

I: …And, how are your class sizes in general….. What, actual, class numbers do you have in general?

T: Eh….for grade 8 and 9, the numbers range from 30 to 40 but for Physical Science we decided to cut the numbers so that we can have individual attention…. So you do not have more than 25 learners in a class….

I: So you are comfortable with that for grades 10, 11 and 12

T: Yah, for grade 10, 11 and 12 it is actually better in terms of teaching and the learners…

I: What about the supporting laboratories, are they well equipped to your expectations…

T: ……I think for syllabus requirements, I can't complain, I think they are okay….

I: Okay, what about the behaviour of learners in general, is it okay or not?

T: Ehhh……! Heh! Heh! (Laughing)…… It is difficult to have learners who are all well behaved….but the majority of them are well behaved…..but you find that in each class you always find one or two who are not well behaved…

I: …But is it manageable?

T: Yes, it is manageable…

I: And then something else about the language that they use at school, it is English, I presume……..?

T: Yah, that is the official medium of instruction in this school….

I: How proficient are they, loosely speaking, are they good, bad or average …..that is…. Their command of the English language….you see..

T: Generally, it is average, although there is room for improvement…however, what I realise is that most learners do not read like what we used to do in our times….where you would improve your vocabulary by reading novels…..but this time, they are always with their earphones listening to music, so I don't think they have time to read novels…

I: So are you happy with their command of the English or proficiency as a language of instruction?

T:Yes, but I think there is still need for them to improve….because when you are talking to them "verbally"…they seem to speak good English, but when it comes to writing and understanding, that is something else….

I: Is it "street lingo" or language that is scholarly when they talk?

T: They normally mix up the language…..

I: Okay, let's go to the words that I identified…(in the questionnaire)…They are just 4..

T: Okay…

I: The first word of interest that I identified is *sensitive*……Ehe….can you tell me…according to your own understanding, what does this word mean?

T: *Sensitive*? It depends on the context actually….because you can describe someone's feelings as sensitive… and say that I am very sensitive…., and you can also look at…eh…in lab' you can look at sensitive instruments like ammeters and balances which are able to measure very small quantities.

I: Surprisingly, many of your learners, in fact 15 out of 21 gave the meaning of this word as "something that gets spoilt easily"……do you agree with their views?

T: I don't necessarily agree with them, but it depends on the context in which they put it…

I: Why do you say so….?

T: That's my own opinion….because I always see any reason……..oh….what was your question by the way?

I: I am saying do you agree or you don't agree with their definition and why……..

T: That's why I was saying it depends on the context in which they understood the wood……

I: You know, what I am looking for is to see whether they pick it up from somewhere …..some…some section of their lesson or topic…

T:….It's because when you are…when you are doing some measurements in the laboratory, you may say, do not breath on to this equipment because it is sensitive, then you have to stand somewhere far away like a meter away…so that you do not affect it….

I: I which topic did you use this word?

T: I think when you talk of measurements….yah….measurements

I: Okay, do you normally explain the meanings of such words?

T: Okay, most of the times we just assume that they know the meaning…..unless if there is someone who asks for it….well normally I assume it's a common word…

I: Okay, the next word is *valid*. What does the word valid mean to you?

T: *Valid*…....? Something which holds water….

I: Something which holds what…….?!?!

T:Something which holds water….something reasonable…or something that makes sense…

I: Okay, a good number of your learners said that this word means *brief*...

T: …What?!!!...Brief…! (Laughs)

I: Yes…Well, do you agree with them or you don't….?

T: Ehmmm….I do not want to speak for them, because we do not normally speak of these words regularly in class, so I wouldn't know the reasons why they chose that meaning…

I: Did you ever use it before in a particular topic in the teaching of Physical Science…?

T: It is very possible because ….ehhh…sometimes you are marking there, let's say an exercise, then you say, give me a valid reason meant to explain or describe something…then you say your reasoning was not valid…or something like that…

I: Okay, the third word is *convention*…(Spelling the word)….what I the meaning of this word..?

T:……Convention….(laughing again)…..I remember using this word when teaching organic chemistry…..when naming organic compounds……..you say the I.U.P.A.C. naming is…..then some learners asked what IUPAC meant and then I said, as scientists, you sit down and agree, you see…so that you call this like that…So, anything they sit down and agree on…Also, when you talk of conventional current direction, like in grade 10…..they say current flows from the positive terminal to the negative terminal of the battery…. That is conventional, so I think that word is not very new to them….

I: ….Surprisingly, some say that this word means….a formula of physics…and other said it means…something that was developed a long time ago….Do you agree with them?

T: ….(Giggling)…. "kids" being "kids"…you may never know what they are thinking of all the time but actually this year we actually spoke about this word when we were doing organic chemistry…

I: Okay, now, the last word…..what does the word *disintegrate* to you?

T: …..to break down…

I: ….But some of your learners said it *means to disappear* or to *change colour* do you agree with them or not?

T: …….I am actually surprised when you say this…..changing colour for disintegrate….of course…..maybe it is because we do not normally talk about it anymore….we used to talk about it when we were teaching about *isotopes*…….disintegrates means to release energy in nuclear power, so we don't normally teach each it now…

I: …So you are saying that you haven't used it in any given topic you remember?

T: …No, I don't remember using it recently, but I presume that they meet it in Geography when they talk about the weathering of rocks as disintegration of rocks

I: You mean in other subjects…….Okay…..I want to put you in a tight corner because I am doing a research…..I know it's "off-line" but….you will have to bear with me it this instant…sir!

T: Okay…

I: Can you give me the answer to questions 4, 5, 6, 11 and 12 of the questionnaire….Now it's like the context of this word….(Reading the questions and the possible answers in each case)

T: Question 4, I think I would go for B

Question 5, I would go for A

Question 6, I would go for D

Question 18, I would go for D

Question 20, I would go for A

I: Thank you very much sir, it was a pleasure working with you…

T: Okay, …..wish you the best in your research…

I: Thank you!

3. TEACHER INTERVIEW (SCHOOL L)

Key: *"T" represents the Teacher interviewee; and "I" stands for the Interviewer*

I: Good morning, sir!

T: Good morning…..

I: How are you?

T: Fine

I: Alright… I gave your learners a questionnaire to answer concerning the use of everyday words use in the Physics context and then when they answered them, I marked them and then I interviewed and recorded them…I then analysed several words. This interview with you is based on that interview and questionnaire. I extracted five words that I want to discuss with you…just five of them…..

T: Okay….

I: Alright, in the first place, how do you judge your learners in terms of proficiency in the use of English language, that is in their everyday communication with you, do they communicate well or properly….are they proficient?.....

T: Ahhh…….I would say……Yes, most of them they are not problematic, but I think three or four are not proficient in English. But the rest can express themselves well in English unlike the experience that I had when I was teaching in rural Eastern Cape, where I faced serious challenges with language proficiency…..the learners would hardly understand you when communicating in English

I: Okay….what about the labs, are they well equipped to your satisfaction?

T: To be honest with you, I don't have problems, even if I do not teach in a Lab' per ser, I get all the equipment I want and teach science…..I got everything right here…….test tubes…..and stuff like that……

I: …..In terms of learners' behaviour, are they okay or they are problematic?

T: Mmmhhhh! They are not problematic

I: The next one is about class sizes, are they too big or too small to your liking?

T: My classes are not too big, for example my Maths class is 35 and Physical Science is 21….

I: Oh, you teach Maths' as well? Are you comfortable with that?

T: Yes, my Maths class is the one that is big but that is not a problem, I'm okay

I: Alright….There are certain words in the questionnaire that were……actually interesting, for example, the word….eh……*sensitive*……In your own understanding, what does this word mean to you……..? (Spelling the word)

T: Ehhmmm…….I would say it means *touchy*... kind of…

I: But some of your learners chose the meaning of the word as " to getting very spoilt easily"…..and others say….Ehhh (clearing throat)…."for sensitive people…..". Do you agree with them or not….?

T: No, the word means something *touchy*… now, to say only sensitive people must use a sensitive thing is farfetched……

I: Have you ever used this word before in your teaching? And, if you can remember the topic in Physical Science, where you used the word with your learners, it would be fine…

T: Ehhhh, I don't remember….

I: Okay, let's go to another one……the word *valid*……According to your own understanding, what does the word *valid* mean to you?

T: Ehhhmm, I think I would mean "tried and tested", "correct" or "something that is generally accepted"

I: Your learners said the word valid means *brief*. Do you agree with them?

T: I don't …..

I: Why, There are your learners, you taught them…..

T: Wait, Wait! Yes……they are my learners but I do not think I have ever taught them valid as brief……..remember……in Physical science, like when write the final answer, I say they have to put units that are valid, meaning correct (units)

I: Where do you think they pick this meaning from?

T: ……..You know learners, even if you teach them something correct, they prefer to use words that are popular or cool with them, like the one they use for internet texting

I: And then the next word is *source*. What do you understand by this word……its meaning?

T:…..(prolonged silence)……okay where something comes from……

I: …..And then so of your learners said it means *loudness* and others said it means and others said it means *pitch*… Do you agree with them……?

T:……Hmmmmm……. (Prolonged silence)..

I: ……that is terms of the source of sound…

T: Ah, as a source of sound……! Where the sound comes from is the origin, the source…..I believe that is where the learners meanings come from because they (studied the sound waves)

I: In this situation, you teach these learners…..you know them….now you see that they have a tendency of using words the way you did not teach them (laughing)….definitions coming from somewhere else……such simple words that you think they know their meanings…..but they answer otherwise…and even wrong meanings…..So do you actually explain the meanings of these everyday words each time you use them……even if they are simple like this?

T: Ahhm……..I wouldn't say, yes I explain such words always….

I: Why don't do that?

T: I can't say that every lecture (Lesson) I have to explain words to them…. You know with Physical science, we don't have time on our side…..okay….you are not finishing what you want to teach…but of the times they know…..

I: But, don't you think it is important?

T: Yah, it is important…and if they ask yes, I explain……

I: What do you think teachers must do, should they take it for granted that they (learners) know and progress?

T: No, I don't……I don't agree with that..

I: In future, are you going to (take this seriously) explain the (contextual) meanings of the words?

T: Yes of course, I've always been doing that but not very much…

I: Okay, can you answer for me the following questions which are now in the context of Physics, question 5

T: (Reading aloud). The answer is A, to measure very small things

I: Okay, the other one is question number 6, what answer would you prefer?

T: …..(Reading)…I choose "sound"

I: The next one is question number 24

T:…(Reading aloud)…I would go for " Where it came from.."

I: Okay, I think that's all. Thank you very much for the interview, it was a pleasure

T: Same to you….

4. TEACHER INTERVIEW (SCHOOL N)

Key: *"T" represents the Teacher interviewee; and "I" stands for the Interviewer*

I: Good morning, sir!

T: morning…..

I: How are you?

T: I am fine

I: Okay… Remember, last time your learners did a questionnaire…..in fact they answered a questionnaire on the use of everyday words…..they wrote that/ they answered it and afterwards, I had an interview with them, just to ask them about the answers, what they thought about their answers …So I am going to ask you about a few things about your learners, their background and the way they answered the questions in terms of the use of words in Physical Science…Okay, just to start with the ……can you tell me where most of them come from, like locations, suburbs or surrounding areas….I just want to know about your school….

T: Eh, I think the majority comes from the townships (locations)……eh, maybe 20% come from the surrounding areas…….

I: What type of surrounding areas is it….you can mention the names, not your school's name (for confidentiality sake)….?

T: ….. Malvern area is the suburb here……

I: ….Do you consider it rich, poor or medium density…

T:…..The area is mixed…it was a low income area

I: And now in terms of the language, when the learners are talking, do they communicate in English or Afrikaans or other languages….

T: In class, they use most particularly English….

I: Do you allow them to use other languages in class?

T: I do allow them to express themselves in Zulu or Sotho……most of them are Zulu speaking (home language)….So if I see that they can't express themselves correctly or that they are struggling to come up with answers in the English medium, I allow that.. I say tell me in your native language then I translate it to English and then I move on

I: Is this a fee paying school?

T: Yes, this is a fee paying school…

I:Is it very expensive?

T: No…I can say it is still low compared to other schools in the area…..maybe the lowest.

I: How are your Labs? Are they well equipped?

T: No, they are not well equipped…..there is a lot of improvising that has to be done

I: So, how do you go around the issue of explaining words that are difficult where you need apparatus to show them something (as you explain) in Physical science?

T: Ehh, mostly……sorry, I do not understand the nature of the question

I: There are some things in Physical Science where you actually need to show them where (theoretical) explanations become very difficult if you do not show practically with certain difficult words...…..

T: Basically, what we have the privilege of is having the Gauteng-On-Line internet centre, we can utilise that internet centre for explaining and examples……topics like the Electromagnetic field….I taught that using the internet…for the applications, they could see it (simulations) how the lines run and what is happening….all these things…

I: Now let's go to the questions that they answered…..question number 4 for example which reads as follows: (Reading question 4 of the questionnaire). They say that they had never met this word before in Physical science but yes in other subjects and area. Are they telling the truth?

T: …(Laughing) You have to be very careful with that class.

I: How is the class?

T: You need to be very careful with that class. Sometimes it will say some things just to test or to pull you out of what you are trying to say to them…..if you look at that word *characteristic*, and then you can say: what are the characteristics of metals?, just like that…

I: So they have met the word before?

T: They have met the word before in grade 10 because it is the very same class I taught in grade 10 and I taught them again in grade 11…so they have met almost a lot of these words if you look at these learners, there are two or three learners that will answer everything honestly to you, the rest will create jokes

I: Is it their back ground, where they come from, that make them behave that way?

T: If they do not understand something, they tend to make jokes and if they understand, you see them being serious and they will be quite… so you need to get them to a point where they understand concepts…but the moment they lose you, their concentration goes and jokes come up….

I: Let's put you in a tight corner….question number 5 (Reading it aloud). You have met this word before…..

T: Let me think of the topic…

I: But you have met it before…

T: Many times……Yah, when we were using the pH scale…when we were measuring the pH of the…..(inaudible)….when we were using the pH meter, I told them that the electrodes… the front part of the electrode is very sensitive, it is a very delicate instrument to work with… that would affect the experiment….

I: Many of your learners said that the answer there was "the instrument gets spoilt very easily" ……..then I said okay, if you say it gets spoilt easily, are you saying that the instrument gets damaged…?

T: No…when we were using it we meant to say, if there is a slight change in the pH of your solution, it would pick it up…they should tell you that the answer is A not D….that's what they need to know…

I:Okay, now if you look at these words, they look like general…..easy. But the learners get answers wrong….what do you think this is coming from, actually? It is an easy word…they have seen it many times before, but when it comes to Physical Science, they get it wrong……

T: Yah, you have to understand that science has got its own jargon, you know….it's language is quite different from what we are used to…especially in cases like this….eh…in various cases, the words that we were using…they mean something according to what the dictionary is saying…is telling them but in science, it means something else…it's referring to something else, so you have to understand that almost out of 600…5 of them, the meaning in the dictionary…when we say *sensitive*, it means that….so only when it changes, it becomes a problem…

I: Now if you realise that situation *per ser*… that words change meaning, did you actually explain most of the cases such words so that they can understand the contextual meaning…

T: Yes…I try to explain because mostly when we are addressing the test that was written before, the memorandum (answers) or whatever the case maybe…. The bottom line there….the bottom problem that I pick up from the learners is that they do not understand what the question was saying…..

I: Ehhmm..

T: When I explain what the question was saying, they end up having answers which happen to be correct, because then I see that…oh well…that is what happened in the exam, they could not pick up the trick within the words

I: Let's talk about something…in terms of experience,…how many years of teaching experience do you have? You say you taught this class since grade 10…..

T: I taught them from grade 9 and it was my third year this year….which means 50% of the class and some of them two years

I: so you know them very well…..

T: Yah….not very well but… when I read the question, I understand some of the things….how they are going to approach the question…..they still fight very hard to get to….to move from taking a……an idea from the book and applying it in the question paper….that's still a huge migration for them to do…to apply that idea

I: We seem to have a problem here…..now what's your suggestion about this…since you have seen that there is a problem here about these words…the…. the learners seem to use other means of defining these words, what do you think should be done?

T: You see, learning area s like Mathematics and Physical science, they interlink very closely...that's one way of looking at it…I'm saying that there was one class that was saying that the circle I Technology (subject) is note the same circle in Mathematics…..they will separate one learning area from another….If it's Maths it's Maths and they leave it there, then when it is Physical science, they say let's leave it there, it's separate, they can't interlink them…My suggestion is that they need to interlink the subjects like Mathematics, Technology and Physical Science….

I: That link….should it be created by you as a teacher…

T: Yes, you need to interlink the topics as you see them happening in their area…..those words, they mean the same thing but that they are explained in a different way…

I: Thank you very much, sir….

T: You are welcome…..

I: In future, can I come back and probe you on some other issues of my investigation…

T: I am very interested to know the outcome of this research…..because it helps in the development of learners

I: Thank you very much……..

5. TEACHER INTERVIEW (SCHOOL M)

Key: *"T" represents the Teacher interviewee; and "I" stands for the Interviewer*

I: Hallo....Good morning, sir!

T: Good morning…..how are you

I: Fine and you

T: I am fine

I: Okay, sir … Remember, last time I did an interview with your learners after I gave them a questionnaire which they had answered…..about the use of everyday words in Physical Science…..Okay?....after they answered those questionnaires..eh,...I picked a few words that were of interest to me. It is precisely on those words...that I want to talk to you about in today's interview....Please feel free in this interview.....don't feel pressed oh...Heeh! Heh! (Laughing)Feel biased in any way. I will not mention your name in any of my research work....You are going to be an anonymous person throughout...okay

T: That's fine.....

I: Eh, in your school I identified something like....eh....1..2..3, 4....eh..5 words that interested me..Eh... The first one is the word *sensitive*....Eh...to you...what does the word sensitive mean?

T: Eh..the word *sensitive*....ehhh...applicable to the teaching and learning of science..?

I: ....Yes..and you can also explain it to me generally....whatever, the way you understand it...
T: …..The way I understand it...eh,...I usually..possibly..in measurements in a scale that is very accurate.....minute...

I: Okay, many of your learners actually said, the meaning of the word *sensitive* is....."getting spoilt very easily". Ehh....Do you agree with your learners in terms of the definition of this word?

T: ...(Silence)....No!..

I: Why don't you agree with them?

T: ...Because it's not what I taught them...it's not the way how we used the word *sensitive* in my class.....

I: .....okay...so are you talking in terms of your subject or in general

T: In terms of my subject.....

I: Tell me, in which sections or topics of your subject do you use such a word?

E: We were dealing with ...ehhh....vectors and forces, where we had to do a practical (experiment) ...we had to take very accurate measurements and where we were....eh...remember that trolley...the trolley practical?...

I: Oh yes...I also teach Physical Science...

T: ...Yes…..At the moment when you let the trolley run off, you need to be very accurate there and when you stop your timer.....you need to be very accurate there.... and that constitutes the sensitivity of the results...of measurements that you read off.

I: Do you normally explain or provide any meaning to the words to your learners...like the one you have just explained...?

T: In some instances I do.....but not all the time....I cannot say I explain. There are terms that are particular or new to.....or specific to the topic.....that aren't generally derived from the situation.....

I: So it generally depends on you...when you feel that you need to explain,...then you do it?

T: Yes.

I: But now some of these word look like simple everyday words that they meet outside the classroom....it is highly likely that they have met them before .....so how, now, do you judge when to explain and when not to.....

T: It is very difficult and I can't say…..or perhaps a moment whereby I sat down and picked out a few general words because .....but by virtue of the fact that they are general, one automatically assumes that they would know them.....not to spent 3 or 4 minutes of the lesson explaining the words...

I: Now, do you explain this word in terms of the science context or general...

T: What I do with words that I see that they might just be out of the norm, I first take it from the everyday context.... at times I ask them to check the dictionary, I say.....What does this word mean?.....Find that....Tell me that...and then from there, I derive....I bring it to the science context....I think that one is very important because it actually builds the whole foundation of the word...

I: Okay, let's progress because we still have three or so words to discuss...The next word is *valid*...what does this word mean for you.....

T:....."Valid"....Suppose it was a hypothesis...eh, maybe in a practical or investigation. If we agree with the hypothesis, then our supposition or hypothesis is valid or it holds true.

I: Alright, many of your learners said that the meaning of the word "valid" is "brief". Do you agree with them?

T: That is way off.....

I: Way off....totally opposite...? Haa! Haaaa! (Laughing)

T: Noooo! Ahhh? There are some word that we do take for granted but we cannot see how one can relate "valid" with "brief"...I cannot explain their thinking.....Heeh! Heh! (Laughing).....

I: So where do you think they pick up such a meaning?

T: Such a number of them....valid for brief? No I...I cannot talk for them..

I: In which topic did you use this word?

T: Whenever we do a practical and sometimes when we approve, like in Newton's Laws, remember when we derive the gravitational acceleration in relation to Newton's Law of Universal Gravitation.....so we can say this equation is valid because the equation holds true....

I: The third word is *convention*..... (Spelling it)....What is the meaning of this word to you?

T: As per agreement...

I: Okay...but then your learners say it means “a formula for physics” and then some say it means “something developed a long time ago”. Once more...do you agree with them?

T: ..... (Laughing aloud).....come again.....

I:..... (Interviewer repeats as per request)...

T: ...Ahhhh, well if I was a learner, I would probably go for the second one....

I: So as a teacher why go with that?.....not necessarily...with a convention...maybe we can think of the mother body of what we think we are running and then we choose certain word or rule .....like in organic chemistry...the rules are changing here and there. So when I teach in class, I need to update them with the new rules... as agreed upon

I: Which sections...Which subjects...do you normally encounter the word?

T: I use it in Organic chemistry as I have said for grade 12 but not for grade 11 and in electricity about the movement of charge ...by convention...that one I have to tell them.

I: Alright...And then now the forth word...The word *disintegrates*....What is the meaning of the word “disintegrate” to you?

T: it is to break down....

I: And some of your learners say it means “to disappear” and some said it means to “change colour”...do you agree with them?

T: By the way, which class was this....11B or 11C?

I: .....No I don’t, know....

T: If it was 11B class, I would agree but if it was 11C, not really...because now.....

I: Remember I did one of your classes....I do not know which is which there...Let’s deal with this one...

T: With this one, 11B, they could argue their way out and i would kind of agree with them...If you look at it chemically, breaking down can mean change of colour or disappearance of colour.....But just as a physical quantity...No!

I: So where do you think they picked up this definition?

T: Well, disintegrate as change of colour, generally I think it was the best answer for them to pick but I can’t explain

I :(Laughing) ....You can’t explain that...Ehhh, the next word which was of interest to me was question 25...Yah! What does the word adjacent mean to you?

T: Next to...

I: Okay....And then your learners chose something otherwise....with some saying it means “identical in every way”.....Okay, where do you think they picked up this one from?

T: ..... (Silence)...

I: Maybe let’s ask first that ...Do you agree with them?

T: Nooo!, I don’t! In my subject and Mathematics they always confuse the word *parallel*

I: So you strongly suspect they picked up the confusion from Mathematics....?

T: Yes, I strongly suspect that....like in triangle

I: Now, let's go for a few things about the background of your school, eh, what type of school is this one...former model C or something else?

T: It is a former model C school

I: Fee paying...?

T: Yes...

I: The sizes of the classes in general, are you happy about them...are they too big or okay? And the numbers

T: I think I am okay... 30 to 32...

I: So they are manageable?

T: Yes

I: The Laboratories, are they well equipped?

T: No, Laboratories need to be looked into….I am not happy with them

I: And now, finally, do you think your learners are proficient in English....when they express themselves, are they proficient to your satisfaction?

T: No, they are not...maybe they are in what you call modern lingua but that is not English to me....

I: So they cannot express themselves well

T: They can't express themselves well, and when they write it not up to standard...

I: Now if I were to give you one or two of the questions that they answered so that I see what answers you will get yourself, is it okay. Like question number 5...., what answer would you choose?

T: ... (Reading aloud) .....I would choose A

I: Question 6....

T: (Reading aloud)..... I would go for D

I: Last one; sorry for pushing you...Question 20

T :....(Reads aloud)....A is the answer

I: Thank you very much sir!

APPENDIX E

TABLES OF SCORES PER SCHOOL

SCHM	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31
QUE. 1	B	√	√	√	√	√	B	B	√	√	√	√	√	D	√	√	√	√	B	√	√	√	√	√	√	√	√	B	B	√	√
QUE. 2	√	√	A	A	√	√	A	C	√	√	√	√	√	√	A	√	A	√	√	√	A	A	√	√	√	√	C	√	√	√	C
QUE. 3	√	B	B	√	B	D	B	B	D	B	D	D	√	D	B	√	B	√	D	√	√	B	√	√	B	√	√	A	√	√	B
QUE. 4	D	C	√	C	C	√	C	√	√	C	C	√	C	C	√	√	C	√	C	√	C	D	√	√	√	√	√	C	C	√	√
QUE. 5	B	D	D	B	√	D	D	C	D	√	D	D	D	D	D	C	D	D	√	D	D	D	D	D	D	D	D	D	√	D	√
QUE. 6	A	C	C	A	C	B	B	C	C	C	C	A	B	C	C	C	C	C	A	C	B	B	√	C	C	A	C	C	C	√	A
QUE. 7	√	√	A	√	D	√	√	√	√	√	√	√	√	√	√	√	√	C	√	√	√	√	√	√	C	√	√	√	√	√	√
QUE. 8	√	D	√	√	B	√	√	√	√	√	A	√	A	√	√	√	A	√	√	B	√	A	√	√	√	A	B	√	√	√	√
QUE. 9	C	C	√	√	√	C	B	√	√	√	√	D	√	D	√	B	√	√	C	√		√	√	√	√	D	√	√	A	√	C
QUE. 10	√	√	√	√	√	√	B	B	√	√	√	√	√	√	√	B	√	√	√	√	√	√	√	B	√	B	√	√	A	√	√
QUE. 11	√	√	√	√	√	√	√	√	√	√	√	D	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUE. 12	D	D	D	√	√	C	√	D	√	D	D	D	A	D	D	√	√	√	√	D	√	√	√	A	√	B	√	√	A	√	B
QUE. 13	C	C	A	√	C	√	√	C	C	√	√	√	B	√	√	C	√	√	√	C	√	√	C	√	√	√	√	A	C	√	A
QUE. 14	C	C	A	√	C	B	A	√	C	√	√	C	√	B	C	√	C	A	√	√	√	C	√	√	C	√	A	√	√	√	√
QUE.	D	√	D	D	A	A	A	B	√	√	B	D	D	√	D	B	B	√	D	√	A	B	B	D	D	D	√	√	D	√	D

15																														
QUE. 16	√	√	√	√	A	√	√	√	B	√	√	√	√	√	√	√	√	√	√	√	A	A	√	B	√	√	√	√	√	√
QUE. 17	√	√	A	D		D	A	√	√	A	D	√	√	A	A	√	√	√	√	√	D	√	√	√	√	√	C	A	√	√	D
QUE. 18	√	√	√	√		B	A	√	√	√	√	√	√	√	√	√	A	√	√	C	√	√	√	√	√	√	√	√	√	√	√
QUE. 19	A	D	B	√	B	D	D	√	√	B	A	B	√	B	√	√	√	B	√	B	B	B	√	√	√	D	B	B	B	A	√
QUE. 20	B	D	D	√	B	C	√	D	√	√	B	D	D	B	B	√	B	D	√	D	√	D	√	B	√	√	√	D	B	D	D
QUE. 21	√	√	√	D	D	√	D	D	√	√	D	D	√	√	√	A	A	√	A	√	√	√	√	√	D	D	A	√	D	√	√
QUE. 22	√	√	√	√	B	√	√	√	√	√	√	√	√	√	√	B	B	√	√	√	B	B	√	√	√	√	√	√	B	√	√
QUE. 23	A	√	A	B	B	A	A	√	A	√	A	A	√	√	B	A	√	√	D	D		√	√	A	√	A	√	√	√	B	B
QUE. 24	√	C	√	C	√	√	A	√	√	√	√	A	√	√	C	√	C	√	√	C	√	√	√	A	√	C	√	√	√	√	√
QUE. 25	√	B	√	B	C	B	B	D	√	B	B	B	D	B	B	D	B		B	D	√	B	√	C	B	B	D	√	D	B	B

Key: M1 – M31 =Learner Code; Sch.= School; Que. = Question

SCHOOL N	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13	N14	N15	N16
QUESTION 1	√	A	√	√	√	√	√	D	B		B	B	B	√	√	√
QUESTION 2	√	√	√	C	A	√	√	A	A	C	C	√	A	C	A	√
QUESTION 3	√	√	B	√	√	√	D	√	√	B	√	√	A	√	B	D
QUESTION 4	D	√	√	√	C	√	D	√	C	D	√	C	C	√	√	√
QUESTION 5	D	D	D	√	D	D	D	D	D	√	D	D	D	D	√	D
QUESTION 6	B	C	√	√	C	C	A	C	A	C	C	C	C	√	√	A
QUESTION 7	√	√	√	√	√	√	√	B	√	√	√	√	√	√	√	√
QUESTION 8	√	D	D	√	√	D	√	B	B	A	√	√	√	√	A	√
QUESTION 9	√	√	√	√	√	B	D	√	√	√	√	√	√	√	√	√
QUESTION 10	√	√	B	√	√	√	√	√	√	B	√	√	C	√	√	√
QUESTION 11	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	D
QUESTION12	√	√	√	√	B	B	√	√	D	√	B	√	B	√	√	√
QUESTION 13	√	√	√	√	√	B	A	C	C	B	√	C	√	√	√	√
QUESTION14	√	√	C	√	√	√	A	C	√	√	√	√	C	√	A	√
QUESTION15	B	A	D	B	A	D	B	D	B	D	A	A	B	D	B	B
QUESTION16	√	√	√	√	√	√	√	√	D	√	B	√	√	√	√	√
QUESTION17	√	√	√	A	√	√	D	√	√	√	√	√	C	√	√	A
QUESTION18	√	√	√	√	√	√	√	√	A	√	√	√	√	√	√	√
QUESTION19	D	√	√	√	√	√	√	√	√	√	B	B	A	√	√	A
QUESTION 20	D	√	√	B	B	D	D	D	√	B	B	B	√	√	√	√
QUESTION 21	√	√	D	√	√	D	√	√	√	D	√	D	√	√	D	√
QUESTION 22	√	√	B	√	√	√	√	√	B	√	√	√	√	√	√	√
QUESTION 23	√	D	D	√	D	D	A	√	B	A	√	D	√	√	D	A
QUESTION 24	√	√	√	√	√	√	√	√	√	√	B	√	A	√	√	√
QUESTION 25	B	√	B	D	√	B	√	√	B	√	C	√	√	√	D	D

SCHOOL Q (N = 21)	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21
QUESTION 1	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	A	√	√
QUESTION 2	√	√	√	√	C	√	√	√	√	√	√	√	C	A	√	√	√	√	C	√	√
QUESTION 3	√	√	√	√	A	√	B	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 4	√	√	√	√	√	√	C	C	√	√	√	√	√	√	√	√	√	C	C	√	√
QUESTION 5	D	D	D	D	D	B	√	D	D	D	D	D	D	D	D	√	√	D	√	√	√
QUESTION 6	C	C	√	√	√	C	√	C	√	A	C	C	C	√	C	C	√	√	C	√	√
QUESTION 7	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 8	√	A	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√
QUESTION 9	√	√	√	√	√	√	√	√	√	√	C	√	√	√	√	√	√	√	√	√	√
QUESTION 10	B	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	B	√	B	√	√
QUESTION 11	B	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 12	√	√	√	√	√	√	√	√	√	√	√	√	√	B	√	√	√	√	B	√	√
QUESTION 13	√	√	√	√	√	√	√	√	√	√	√	√	C	√	√	√	√	√	√	√	√
QUESTION 14	C	√	√	√	√	C	√	√	√	√	√	√	√	√	√	D	D	D	D	√	D
QUESTION 15	√	√	√	√	√	A	D	√	√	B	√	√	√	B	B	D	√	√	A	√	B
QUESTION 16	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 17	√	√	√	√	√	√	√	√	√	D	D	√	D	√	√	√	√	C	A	√	√
QUESTION 18	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	B	√	√
QUESTION 19	√	√	√	√	√	√	√	A	√	A	√	√	√	√	√	√	√	√	√	√	√
QUESTION 20	√	√	D	√	B	D	√	B	√	√	√	√	B	B	√	√	√	D	B	√	√
QUESTION 21	√	√	√	√	√	√	√	√	√	A	√	√	√	√	√	D	A	√	D	√	√
QUESTION 22	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 23	A	√	√	√	√	A	A	A	A	A	A	√	B	A	A	D	√	√	√	√	√
QUESTION 24	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
QUESTION 25	B	√	B	√	B	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

SCHOOL L	L 1	L 2	L 3	L 4	L 5	L 6	L 7	L 8	L 9	L 10
QUESTION 1	√	√	B	√	√	B	√	√	√	√
QUESTION 2	√	√	√	C	√	√	A	√	√	C
QUESTION 3	√	√	√	A	√	√	B	√	√	√
QUESTION4	√	√	√	√	√	√	√	√	B	√
QUESTION 5	D	D	√	D	C	D	D	C	D	D
QUESTION 6	C	C	C	√	C	C	C	√	C	C
QUESTION 7	√	√	√	√	√	√	√	√	√	√
QUESTION 8	√	B	√	√	B	√	√	A	√	√
QUESTION9	√	√	√	√	√	√	√	√	√	√
QUESTION 10	√	√	√	√	√	√	√	√	√	B
QUESTION 11	√	√	√	√	√	√	√	√	√	√
QUESTION 12	√	√	D	√	√	√	B	√	√	√
QUESTION 13	√	√	C	√	√	√	C	√	C	√
QUESTION 14	√	√	√	√	√	√	A	√	√	D
QUESTION 15	B	B	B	√	D	B	B	√	B	D
QUESTION 16	√	√	√	√	√	√	B	√	√	√
QUESTION 17	A	√	√	√	√	√	√	D	D	D
QUESTION 18	√	D	√	√	√	√	√	√	√	√
QUESTION 19	√	√	D	√	√	√	√	√	B	B
QUESTION 20	√	√	D	C	D	D	D	D	√	B
QUESTION 21	√	A	√	√	√	√	D	√	√	√
QUESTION 22	√	√	√	√	√	√	√	√	√	√
QUESTION 23	D	√	B	√	A	√	√	B	A	D
QUESTION 24	√	√	√	√	√	√	C	√	√	√
QUESTION 25	√	√	D	B	√	D	D	√	√	√

SCHOOL D	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23	D24	D25	D26	D27
QUESTION 1	√	√	√	√	√	√	√	√	√	√	√	B	B	B	√	√	√	√	D	D	√	√	√	√	√	√	
QUESTION 2	√	C	√	√	√	√	√	√	A	√	A	C	C	A	A	√	√	√	C	C	A	A	√	√	D	C	√
QUESTION 3	√	√	√	√	√	√	D	√	D	√	√	B	A	√	A	√	√	√	√	√	√	√	√	B	D	B	√
QUESTION 4	C	C	√	C	√	√	C	√	√	√	√	C	C	C	√	C	C	C	C	√	C	C	√	√	√	√	A
QUESTION 5	D	D	D	C	A	C	√	D	D	D	C	B	D	B	C	D	D	D	D	D	D	D	D	D	√	D	√
QUESTION 6	A	A	√	A	C	√	C	√	C	C	C	C	C	B	C	B	B	A	B	B	B	B	√	A	A	B	B
QUESTION 7	√	√	√	√	C	√	√	√	√	√	√	D	D	A	√	√	A	√	√	√	A	A	√	√	A	√	√
QUESTION 8	B	√	√	A	A	A	√	A	A	√	B	B	B	D	A	A	√	√	√	D	√	√	D	√	A	B	A
QUESTION 9	√	√	√	√	D	√	√	√	C	C	C	D	D	C	√	C	D	D	B	C	√	√	C	C	D	D	D
QUESTION 10	√	√	√	B	√	√	B	√	√	√	√	√	B	B	B	√	√	B	B	√	√	√	B	√	√	√	B
QUESTION 11	√	√	√	√	√	√	√	√	√	√	√	√	C	C	√	√	C	√	√	√	√	√	√	√	√	√	√
QUESTION 12	√	√	√	A	√	A	√	√	√	D	√	√	√	√	√	D		√	√	√	√	D	B	B	√	B	√
QUESTION 13	√	√	√	C	√	√	√	√	√	C	C	C	B	C	C	D	B	C	√	A	√	A	√	C	C	√	√
QUESTION 14	D	D	√	C	√	√	C	√	C	√	√	C	√	√	√	A	C	A	C	C	√	A	√	√	C	√	√
QUESTION 15	B	√	√	A	√	D	√	√	B	B	A	B	D	D	B	√	D	B	A	√	A	A	B	B	A	A	√
QUESTION 16	√	√	√	√	√	B	√	√	√	√	√	B	B	√	√	A	B	D	√	√	√	√	√	√	√	√	B
QUESTION 17	√	√	√	D	√	D	D	D	√	√	√	√	A	D	A	√	√	A	√	√	√	√	D	√	√	√	√
QUESTION 18	C	√	√	C	√	√	√	√	√	√	√	√	√	A	√	A	√	A	√	√	√	√	√	√	√	√	√
QUESTION 19	D	D	√	√	√	√	B	√	B	√	√	√	B	B	A	B	B	B	A	D	B	A	√	D	B	D	A
QUESTION 20	√	B	√	B	√	D	B	D	B	D	√	B	C	D	√	D	√	D	√	√	√	√	D	B	√	D	B
QUESTION 21	√	√		A	A	D	D	√	D	√	A	D	√	D	√	D	D	√	√	A	A	A	√	D	D	D	B
QUESTION 22	√	√	D	B	D	√	√	√	√	√	√	B	√	B	B	√	B	√	√	√	√	B	√	B	√	√	√
QUESTION 23	B	√	√	B	B	D	D	A	√	B	√	√	A	√	A	B	A	D	√	B	√	√	B	D	D	√	D
QUESTION 24	A	√	√	A	√	√	C	√	A	√	C	C	A	C	C	A	A	A	√	√	√	√	B	C	B	C	√
QUESTION 25	B	√	B	B	B	B	B	√	B	D	√	B	B	B	√	B	B	B	C	√	D	D	D	B	C	B	C

APPENDIX F

1. REQUEST LETTER FOR PRINCIPALS

Wits School of Education
University of the Witwatersrand
P. Bag 3
Wits 2050
JHB
13 June 2013

Dear sir/madam

RE: PERMISSION TO CONDUCT A RESEARCH PROJECT AT YOUR SCHOOL

My name is Mqabuko Ncube. I am a student in the School of Education at the University of the Witwatersrand. I am doing research on the language of instruction and learning Physics. The study specifically focuses on the non-technical words used in the Physics context that may act as a barrier to learning

My research involves investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms. I was wondering whether you would mind if you allow me to conduct a research project at your school involving your grade 11 Physical science learners. The reason why I have chosen your school is because it is easily accessible to me.

I will use a questionnaire (copy attached) that can be completed in 30 minutes and thereafter, the learners will be interviewed (and audio-taped) in smaller groups concerning their answers to the questionnaire.The research participants will not be advantaged or disadvantaged in any way. They will be reassured that they can withdraw their permission at any time during this project without any penalty. There are no foreseeable risks in participating in this study. The participants will not be paid for this study.

The names of the research participants and identity of the school will be kept confidential at all times and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely

Mqabuko Ncube: (Phone: 072 734 9672-cell; 011 615 7028-work; omncube@yahoo.com)

_____

(Signature)

2. TEACHER'S INFORMATION SHEET

13 June 2013

Dear Educator

My name is Mqabuko Ncube and I am a student in the School of Education at the University of the Witwatersrand.

I am doing research on the language of instruction and learning Physics. The study specifically focuses on the non-technical words used in the Physics context that may act as a barrier to learning

My research involves investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms. I want to investigate why the learners/students find it difficult to understand some scientific terms and concepts in the science classroom in our country. I was wondering whether you would mind if you allow me to conduct a research project with your grade 11 Physical science learners and to interview you. I will use a questionnaire that can be completed in 30 minutes and thereafter, the learners will be interviewed (and audio-taped) in smaller groups concerning their answers to the questionnaire. Your interview will follow after the learners' group interview. The reason why I have chosen your school is because it is easily accessible to me.

Your name and identity will be kept confidential at all times and in all academic writing about the study. Your individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

You will not be advantaged or disadvantaged in any way. Your participation is voluntary, so you can withdraw your permission at any time during this project without any penalty. There are no foreseeable risks in participating and you will not be paid for this study.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,

Mqabuko Ncube: (Phone: 072 734 9672-cell; 011 615 7028; omncube@yahoo.com)

_____

(Signature)

3. TEACHER'S CONSENT FORM

Please fill in and return the reply slip below indicating your willingness to be a participant in my voluntary research project called:

Investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms

I, _____ give my consent for the following:

Permission to be audio taped

I agree to be audio taped during the interview YES/NO

I know that the audiotapes will be used for this project only YES/NO

Permission for interview

I would like to be interviewed for this study. YES/NO

I know that I can stop the interview at any time and don't have

to answer all the questions asked. YES/NO

I know that Mqabuko Ncube will keep my information confidential and safe and that my name and the name of my school will not be revealed. YES/NO

I know that I do not have to answer every question and can withdraw from the study at any time. YES/NO

I know that I can ask not to be audio taped, photographed and/or videotaped. YES/NO

I know that all the data collected during this study will be kept in a secure place will be destroyed within 3-5 years after completion of my project. YES/NO

Sign_____ Date_____

4. LEARNERS' INFORMATION SHEET

13 June 2013

Dear Learner

My name is Mqabuko Ncube and I am a student in the School of Education at the University of the Witwatersrand.

I am doing research on the language of instruction and learning Physics. The study specifically focuses on every words used in the Physics context that may affect learning and understanding.

My investigation involves investigating the learners' understanding of everyday words when used in the physics in South African classrooms. I want to investigate why the learners/students find it difficult to understand some scientific terms and concepts in the science classroom in our country.

I was wondering whether you would mind if allow me to involve you in this study. I need you to help me by answering a questionnaire then interviewing you in a small group. The interview will be audio taped.

Remember, this is not a test, it is not for marks and it is voluntary, which means that you don't have to do it. Also, if you decide halfway through that you prefer to stop, this is completely your choice and will not affect you negatively in any way.

I will not be using your own name but I will make one up so no one can identify you. All information about you will be kept confidential in all my writing about the study. Also, all collected information will be stored safely and destroyed between 3-5 years after I have completed my project.

Your parents have also been given an information sheet and consent form, but at the end of the day it is your decision to join us in the study.

I look forward to working with you!

Please feel free to contact me if you have any questions.

Thank you

Mqabuko Ncube : Phone 072 7349672-cell ; 011 615 7028-work ; omncube@yahoo.com

_____

(Signature)

5. LEARNERS' CONSENT FORM

Please fill in the reply slip below if you agree to participate in my study called: *Investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms*

My name is: _____

Permission to be audio taped

I agree to be audio taped during the interview YES/NO

I know that the audiotapes will be used for this project only YES/NO

Permission for interview

I would like to be interviewed for this study. YES/NO

I know that I can stop the interview at any time and don't have to answer all the questions asked. YES/NO

Permission for questionnaire/test

I agree to fill in a question and answer sheet for this study. YES/NO

I know that Mqabuko Ncube will keep my information confidential and safe and that my name and the name of my school will not be revealed. YES/NO

I know that I do not have to answer every question and can withdraw from the study at any time. YES/NO

I know that I can ask not to be audio taped, photographed and/or videotaped. YES/NO

I know that all the data collected during this study will be destroyed within 3-5 years after completion of my project. YES/NO

Sign_____ Date_____

6. INFORMATION SHEET PARENTS

13 June 2013

Dear Parent/Guardian

My name is Mqabuko Ncube and I am a Student in the School of Education at the University of the Witwatersrand.

I am doing research on the language of instruction and learning Physics. The study specifically focuses on every words used in the Physics context that may affect learning and understanding of Physics.

My research involves investigating the learners' understanding of everyday words when used in the physics in South African classrooms. I want to investigate why the learners/students find it difficult to understand some scientific terms and concepts in the science classroom in our country.

The reason why I have chosen your child's class is because he/she is in a school that I selected for its convenience. I was wondering whether you would mind if your child participates in answering a 30 minute questionnaire and attending an audio tapped small group interview session.

Your child will not be advantaged or disadvantaged in any way. S/he will be reassured that s/he can withdraw her/his permission at any time during this project without any penalty. There are no foreseeable risks in participating and your child will not be paid for this study.

Your child's name and identity will be kept confidential at all times and in all academic writing about the study. His/her individual privacy will be maintained in all published and written data resulting from the study.

All research data will be destroyed between 3-5 years after completion of the project.

Please let me know if you require any further information.

Thank you very much for your help.

Yours sincerely,

Mqabuko Ncube: Phone 072 7349672-cell; 011 615 7028-work; omncube@yahoo.com

_____

(Signature)

7. PARENTS' CONSENT FORM

Please fill in and return the reply slip below indicating your willingness to allow your child to participate in my voluntary research project called:

Investigating the learners' interpretation of everyday words when used in the physics context in South African classrooms

I, _____ the parent of _____

Permission to be audio taped

I agree that my child may be audio taped during the interview YES/NO

I know that the audiotapes will be used for this project on YES/NO

Permission for interview

I agree that my child may be interviewed for this project YES/NO

I know that he/she can stop the interview at any time and does not have

to answer all the questions asked. YES/NO

Permission for questionnaire/test

I agree that my child may fill in a questionnaire for this study. YES/NO

I know that Mqabuko Ncube will keep my information confidential and safe and that my child's name and the name of his/her school will not be revealed.
YES/NO

I know that he/she does not have to answer every question and can withdraw from the study at any time. YES/NO

I know that he/she can ask not to be audio taped, photographed and/or videotaped.
YES/NO

I know that all the data collected during this study will be destroyed within 3-5 years after completion of my project. YES/NO

Parent Signature: _____ Date: _____

8. GDE RESEARCH APPROVAL LETTER

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2014/112

GDE RESEARCH APPROVAL LETTER

Date:	19 June 2013
Validity of Research Approval:	19 June 2013 to 20 September 2013
Name of Researcher:	Ncube M.
Address of Researcher:	P.O. Box 40226
	Cleveland
	Johannesburg
	2022
Telephone Number:	011 615 7028 / 072 734 9672
Fax Number:	011 622 9089
Email address:	omncube@yahoo.com
Research Topic:	Investigating the learners' interpretation of everyday words when used in the Physics context in South African classrooms
Number and type of schools:	FIVE Secondary Schools
District/s/HO	Johannesburg East

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

2013/06/21

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted: 1

Making education a societal priority

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Mkhado@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Dr David Makhado
Director: Education Research and Knowledge Management
DATE: 2013/06/21

Office of the Director: Knowledge Management and Research
9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

9. ETHICS CLEARANCE LETTER

Wits School of Education

27 St Andrews Road, Parktown, Johannesburg, 2193 Private Bag 3, Wits 2050, South Africa
Tel: +27 11 717-3064 Fax: +27 11 717-3100 E-mail: enquiries@educ.wits.ac.za Website: www.wits.ac.za

Student Number:
510552
Protocol Number:
2013ECE132M

Date: 6 August 2013

Dear Mqabuko Ncube

Application for Ethics Clearance: Masters of Science Education

Thank you very much for your ethics application. The Ethics Committee in Education of the Faculty of Humanities, actin on behalf of the Senate has considered your application for ethics clearance for your proposal entitled:

South African High School learners' meanings of everyday words when used in the physics context

The committee recently met and I am pleased to inform you that clearance was granted. However, there were a few small issues which the committee would appreciate you attending to before embarking on your research.

The following comments were made:

- mistakes in the documents to be handed out (letters, questionnaires) should be corrected.

Please use the above protocol number in all correspondence to the relevant research parties (schools, parents, learners etc. and include it in your research report or project on the title page.

The Protocol Number above should be submitted to the Graduate Studies in Education Committee upon submission of your final research report.

All the best with your research project.

Yours sincerely

M Mabeta

Matsie Mabeta
Wits School of Education

011 717 3416

Cc Supervisor: Dr. S Oyoo

APPENDIX G

PHYSICAL SCIENCES PAPER 1 **NOVEMBER 2009**

Section A: (Questions 1, 2 & 3)

This section was generally well answered.

Question 1

This question examined candidates' ability to recall knowledge. All candidates performed according to expectation, although it was disappointing that the candidates in the bottom range (below 40%) performed so poorly – an indication that the majority of them did not prepare well enough for the examination.

Question 2

This question examined candidates' knowledge of the subject. Candidates were given incorrect statements which they had to correct.

Question 2.2 was poorly answered – candidates had little understanding of the principle of conservation of linear momentum. [$\Delta p_{initial} = -\Delta p_{final}$] Momentum is a vector quantity and, for it to be equal, both magnitude and direction have to be equal. Many candidates could not interpret this fundamental property of a vector quantity.

Question 3

Questions 3.1, 3,2 and 3,3 were answered very well.
Question 3.4 was poorly answered.

- One reason for some candidates' poor performance in this question was that the discharge of a capacitor in a circuit was not well understood. More emphasis should be placed on the teaching of this aspect – it is normally taught in Grade 11.

Some information on the discharge of capacitors is given below:

During the discharging of a capacitor

- the charging current decreases from an initial value of V/R to zero.
- the potential difference across the capacitor plates decreases from V to zero when the capacitor is fully discharged.
- the potential difference across the capacitor and the potential difference across the resistor are always equal.
- the potential difference across the resistor (given by $V_R = IR$) decreases from an initial value of V to zero when the capacitor is fully discharged.

Question 3.5 was reasonably well answered, which indicates that, while some centres had a good understanding of the operation of lasers, at other centres this section was not taught and consolidated well enough for candidates to apply their knowledge with the necessary confidence.

PHYSICAL SCIENCE HIGHER GRADE PAPER 1 NOVEMBER 2004

Many candidates are losing marks unnecessarily by not doing the following when answering a question:

1 Starting the calculation with the correct equation
2 Supplying the correct SI unit in the final answer
3 Showing substitution into the correct equation

A question-by-question analysis follows:

QUESTION 1

Candidates answered this question poorly.

QUESTION 2

This question was poorly answered.

2.1 Candidates struggled with trig ratios.
2.2 Candidates answered this question poorly.
2.3 Candidates struggled with trig ratios.
2.4 Candidates found it difficult to resolve forces into horizontal and vertical components.

QUESTION 3

The following equations were not accepted:

- $u = \frac{s}{t}$ $a = \frac{v}{t}$ $\Delta t = -5\ s$

3.1 This was well answered. Pay attention to the equation $v = \frac{\Delta s}{\Delta t}$

3.2 Candidates had difficulty finding Δt.
Candidates could not interpret a negative acceleration.
Candidates swopped u and v when calculating the acceleration.

3.3 Candidates end with a negative acceleration in 3.2 and the substitute a positive acceleration
in 3.3.
That is incorrect.

3.4 The graph was poorly answered.
Velocity vs time graphs (constant acceleration) cannot have curves. They can only be straight lines.

QUESTION 4

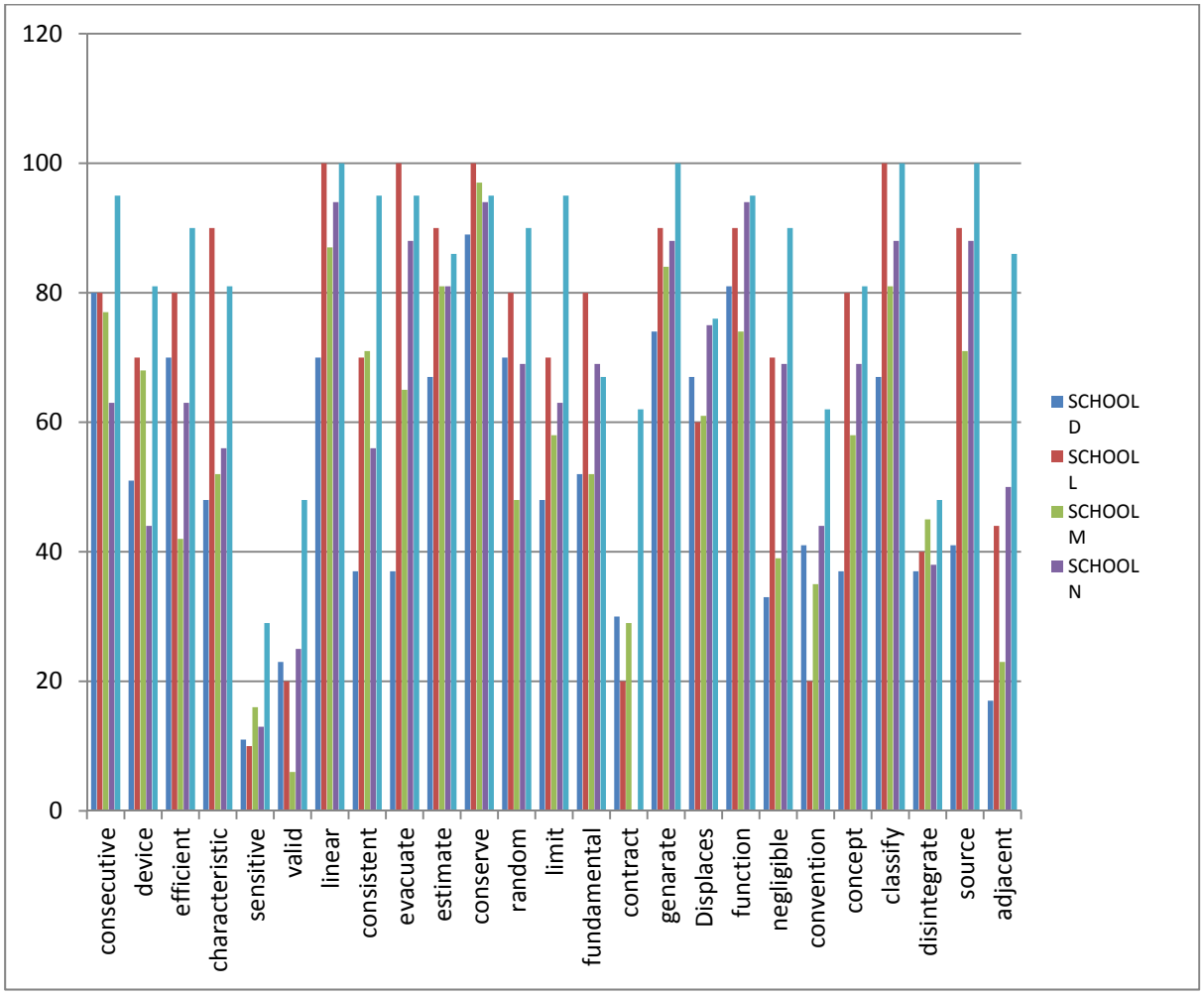
$s = \frac{1}{2} at^2$ is not an acceptable equation. Candidates using this will be penalized in future.

4.1 This question was well answered. The following must be brought to the attention of the future candidates:

- s and a(g) must have the same sign.

APPENDIX H

Summary of performances per school per item



APPENDIX I

Distribution of correct scores per items per school

Question	Word	% correct	% correct	% correct	% correct	% correct
		School D (n=27)	School L (n=10)	School M (n=31)	School N (n=16)	School Q (n=21)
1	Consecutive	81	80	77	63	95
2	Device	51	70	68	44	81
3	Efficient	70	80	42	63	90
4	Characteristic	48	90	52	56	81
5	Sensitive	11	10	16	13	29
6	Valid	23	20	6	25	48
7	Linear	70	100	87	94	100
8	Consistent	37	70	71	56	95
9	Evacuate	37	100	65	88	95
10	Estimate	67	90	81	81	86
11	Conserve	89	100	97	94	95
12	Random	70	80	48	69	90
13	Limit	48	70	58	63	95
14	Fundamental	52	80	52	69	67
15	Contract	30	30	29	0	62
16	Generate	74	90	84	88	100
17	Displace	67	60	61	75	76
18	Function	81	90	74	94	95
19	Negligible	33	70	39	69	90
20	Convention	41	20	35	44	62
21	Concept	37	80	58	69	81
22	Classify	67	100	81	88	100
23	Disintegrate	37	40	45	38	48
24	Source	41	90	71	88	100
25	Adjacent	19	60	23	50	86